2015

College of Engineering and Computing Graduate Catalog

Nova Southeastern University

Graduate Catalog

2015–2016

College of Engineering and Computing
Nova Southeastern University
3301 College Avenue, Carl DeSantis Building
Fort Lauderdale, Florida 33314-9918

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July 31, 2015

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Governing Documents

The *Graduate Catalog* of the College of Engineering and Computing is the governing document for all graduate program-related information. Please become familiar with the policies and procedures contained within it. Official versions of the catalog will be posted to the college's website. The catalog posted most recently to the website supersedes previous web and printed versions. The NSU *Student Handbook* specifies rights, responsibilities, and specific university policies and procedures. It may be downloaded from the college's website. Failure to read the catalog and handbook does not excuse students from the rules, policies, and procedures contained therein. If there is any conflict between the information contained in the catalog and handbook and that contained in any other document, the information in the catalog and handbook prevails. Policies, regulations, requirements, and fees, are necessarily subject to change without notice at any time at the discretion of the Nova Southeastern University administration. The university reserves the right for any reason to cancel or modify any course or program listed herein. In addition, individual course offerings may vary from year to year as circumstances dictate. The university's detailed policy on disabilities is contained in the NSU *Student Handbook.* Student requests for accommodation based on ADA will be considered on an individual basis.

Accreditation

Nova Southeastern University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools (1866 Southern Lane, Decatur, Georgia 30033-4097; telephone number 404-679-4501) to award associate's, bachelor's, master's, specialist, and doctoral degrees. NSU has been designated a National Center of Academic Excellence in Information Assurance Education by the U.S. National Security Agency and the Department of Homeland Security. Its curriculum in information security has been certified by NSA for compliance with CNSS standards. The university has been awarded a chapter of Upsilon Pi Epsilon (UPE), the International Honor Society for the Computing and Information Disciplines. Most of the college's graduate programs have been certified for inclusion in the Southern Regional Education Board's Electronic Campus.

Notice of Nondiscrimination

Nova Southeastern University admits students of any race, color, sex, age, nondisqualifying disability, religion or creed, or national or ethnic origin to all rights, privileges, programs, and activities generally accorded or made available to students at the college, and does not discriminate in administration of its educational policies, admissions policies, scholarship and loan programs, and athletic and other college-administered programs.

Published July 31, 2015.

Academic Calendars

(Please refer to the college website for a more detailed calendar.)

Fall 2015 **08/24/15 – 12/13/15**

Registration Period (no Late Fees):	05/04/15 – 08/13/15
Late Registration Period (with Late Fees):	08/14/15 – 08/23/15
First Day of Term:	08/24/15
Drop/Add Deadline:	08/30/15
*New Student Orientation:	08/27/15
*1st Cluster Meeting Dates:	08/28/15-08/29/15
Drop/Add Deadline:	08/30/15
Observed Holiday:	09/07/15 (Labor Day)
*2nd Cluster Meeting Dates:	10/16/15 – 10/17/15
Last Day to Withdraw from a course with final grade of W:	11/22/15
Observed Holiday:	11/26/15 – 11/27/15 (Thanksgiving Day and following)
Last Day to Request an Incomplete:	11/29/15
Last Day of the Term:	12/13/15

* Indicates relevant for doctoral students only.

Winter 2016 **01/04/16 – 04/24/16**

Registration Period (no Late Fees):	10/05/15 – 12/25/15
Late Registration Period (with Late Fees):	12/26/15 – 01/03/16
First Day of Term:	01/04/16
Drop/Add Deadline:	01/10/16
*New Student Orientation:	01/14/16
*1st Cluster Meeting Dates:	01/15/16 – 01/16/16
Observed Holiday:	01/18/16 (Martin Luther King Day)
*2nd Cluster Meeting Dates:	03/04/16 – 03/05/16
Last Day to Withdraw from a course with a final grade of W:	04/03/2016
Last Day to Request an Incomplete:	04/10/16
Last Day of the Term:	04/24/16

Summer 2016 **05/09/16 – 08/14/16**

Registration Period (no Late Fees):	03/21/16 – 04/29/16
Late Registration Period (with Late Fees):	04/30/16 – 05/08/16
First Day of Term:	05/09/16
Drop/Add Deadline:	05/15/16
*1st Cluster Meeting Dates: (tentative)	05/20/16 – 05/21/16
Observed Holiday:	05/30/16 (Memorial Day)
Observed Holiday:	07/04/16 (Independence Day)
Last Day to Withdraw from a course with final grade of W:	07/24/16
Last Day to Request an Incomplete:	07/31/16
Last Day of the Term:	08/14/16

Contents

Nova Southeastern University (NSU)

NSU is the largest private, not-for-profit institution in the United States that meets the U.S. Department of Education's criteria as an Hispanic-serving Institution. NSU provides high-quality educational programs of distinction from preschool through the professional and doctoral levels, as well as service to the community. It prepares students for lifelong learning and leadership roles in business and the professions. It offers academic programs at times convenient to students, employing innovative delivery systems and rich learning resources on campus, online, and at distant sites. The university fosters inquiry, research, and creative professional activity by uniting faculty members and students in acquiring and applying knowledge in clinical, community, and professional settings.

Located on a beautiful 314-acre campus in Fort Lauderdale, Florida, NSU has 27,000 students and is the second largest private, non-profit university in the Southeast United States. NSU awards associate's, bachelor's, master's, educational specialist, doctoral, and first-professional degrees in more than 100 disciplines. It has colleges of humanities, arts, and social sciences; natural sciences and oceanography; psychology; education; business and entrepreneurship; engineering and computing; law; health care; nursing; medicine; dentistry; optometry; pharmacy; and an honors college. The institution's programs offered through the Family Center and University School include innovative parenting, preschool, primary, and secondary education programs. Its programs are offered in Fort Lauderdale as well as in regional campuses and other sites throughout Florida, across the nation, and in the United Kingdom, China, Korea, Mexico, Belize, and the Caribbean. Despite the geographic diversity of sites where classes are offered, approximately 90 percent of the student body attends classes in Florida.

The university's library system is composed of the following four libraries: the Alvin Sherman Library, Research, and Information Technology Center; the Shepard Broad Law Library and Technology Center; the William S. Richardson Ocean Science Library; and the Health Professions Division Library. The NSU libraries' online catalog, NovaCat, is accessible to students and faculty members wherever they may be located. Online subscription databases complement the print holdings and provide full-text resources. NSU is a member of several cooperative networks and is able to obtain books and periodicals through interlibrary loan quickly and efficiently. NSU students may also use many other libraries. The university continues to expand its library to meet the needs of its growing community. The Alvin Sherman Library, Research, and Information Technology Center is a joint-use facility with the Broward County Board of County Commissioners and is one of the largest libraries in Florida. This five-story, 325,000 square-foot facility has 1,000 user seats, 20 electronic classrooms, and a 500-seat auditorium.

Nova Southeastern University has produced more than 170,000 alumni. Since 1971, it has enjoyed full accreditation by the Commission on Colleges of the Southern Association of Colleges and Schools, the regional accrediting body for this region of the United States.

The success of NSU's programs is reflected in the accomplishments of its graduates, among whom are:

- Forty college presidents and chancellors
- More than 100 college vice presidents, provosts, deans, and department chairs
- Sixty-five school superintendents in 16 states, and nine of the nation's largest school districts
- Hundreds of college and university faculty members and administrators nationwide
- More than 100 high-ranking United States military officers, including admirals and generals, and presidents, vice presidents, executives, middle managers, and researchers at companies such as American Express, AT&T, BellSouth, Boeing, Cisco, Dell, Ford, General Dynamics, Hewlett-Packard, Lockheed Martin, IBM, Microsoft, Motorola, Nokia, Northrop Grumman, Oracle, Pratt & Whitney, Sprint, Sun Microsystems, Texas Instruments, Verizon, and Walt Disney

The College of Engineering and Computing

Mission Statement The College of Engineering and Computing conducts basic and applied research and provides programs of study across the disciplines within engineering, computing, technology, information systems, and cybersecurity. The college's students learn to become reflective scholars and professionals with a critical understanding of theory and practice while acquiring the training and qualifications necessary for advancement. The college strives to meet the needs of a diverse student population using advanced technologies and effective methods of on-campus and online delivery.

The College of Engineering and Computing (CEC) prepares students to meet the technological challenges of today. Drawing on 40 years of institutional experience in computing education and research, and 30 years of experience in innovative program delivery, CEC offers focused and flexible programs aligned to industry's most sought-after fields to help students reach their full potential. CEC has a distinguished faculty, evolving curricula, and an alumni network that integrates 40 years of graduates from computing disciplines at NSU. CEC has flexible online and campus-based formats for its five bachelor's, five master's, and three Ph.D. programs as well as for its certificate programs.

The college welcomes part-time and full-time students, whether on-campus or online. Undergraduate on-campus students participate in day and evening programs and may have the opportunity to apply to the Dual Admission program that automatically reserves a seat in one of CEC's graduate programs. Master's students can complete on-campus and video-conferenced evening degree programs tailored to meet the needs of Florida residents. Online master's degree programs require no campus attendance and are available to students worldwide. A unique hybrid executive Ph.D. program blends on-campus limited weekend meetings with online interaction. The college's M.S. students in most programs may apply for early admission into a Ph.D. program, which provides the opportunity to earn the doctorate in a shorter time.

CEC has facilities to support hands-on instruction for students to learn and research computing and engineering including mobile application development in the Mobile Computing Laboratory (MCL); areas of distributed systems with an emphasis on designing, implementing, and evaluating systems in the Distributed Systems (CLOUDS) and Security Robust Distributed Systems (SARDIS) laboratory; and more.

The college's research advances knowledge, improves professional practice, and contributes to understanding in the engineering and computing fields. In addition to its regional accreditation by the Commission on Colleges of the Southern Association of Colleges and Schools, NSU has been designated a National Center of Academic Excellence in Information Assurance / Cyber Defense Education by the U.S. National Security Agency (NSA) and the Department of Homeland Security (DHS). NSA and DHS have certified that NSU's curriculum in information security meets or exceeds the requirements and standards expected of a leader in cybersecurity research and education.

Collaborative programs include the U.S. Army's eArmyU initiative and the Southern Regional Education Board's Electronic Campus. The College of Engineering and Computing further encourages students to participate in their student organizations including student chapters of the Association for Computing Machinery (ACM) and the Association for Information Systems (AIS), and IEEE; the Graduate Student Government Association; and Upsilon Pi Epsilon (UPE), the International Honor Society for the Computing and Information Disciplines.

All M.S. programs employ a three-term format: Fall (16-week term starting in August), Winter (16-week term starting in January) and Summer (14-week term starting in May).

All Ph.D. programs employ a semester format, which includes two 16-week terms a year for course work. The fall term starts in August and the winter term starts in January. While taking courses, students attend

four cluster sessions per year (two per term), each held over a Friday and Saturday on the university's main campus. These cluster weekends bring together students and faculty for participation in courses, seminars, and dissertation counseling, and provide ample opportunity for student-faculty and student-student interaction. Between sessions, students work on course assignments and research, and participate in online activities that facilitate frequent interaction with the faculty and with other students. There is a third, 14-week summer term in which doctoral students can register for dissertation or possibly other courses.

Online students use the web to access course materials, announcements, email, distance library services, subscription library databases, and other information and for interaction with faculty and fellow students. Online, interactive learning methods are used throughout the instructional sequence based on the use of a web-based course management system. Online activities facilitate frequent student-to-faculty and student-to-student interaction. They are supported by threaded discussion boards, white boards, videoconferences, email, and other online tools.

Degrees and Programs of the College of Engineering and Computing

Bachelor of Science (B.S.)

- Computer Engineering
- Computer Information Systems
- Computer Science
- General Engineering (begins fall 2016)
- Information Technology
- Software Engineering

Certificate

- Web Programming and Design

Master of Science (M.S.)

- Computer Science (concentrations in theory, software engineering, computer systems, database, security, and real-world computing)
- Information Security
- Information Technology (concentrations in application development, database, and system administration)
- Management Information Systems (optional concentrations in business intelligence/analytics, enterprise systems, human-computer interaction, information security management, learning technology, and web management)
- Software Engineering

Doctor of Philosophy (Ph.D.)

- Computer Science
- Information Assurance
- Information Systems (optional concentration in information security)

Graduate Certificates

- Information Security Management (see the section M.S. in Management Information Systems)
- Business Intelligence / Analytics (see the section M.S. in Management Information Systems)

Collaborative Efforts with other NSU Programs

- College of Humanities, Arts, and Social Sciences
    - M.S. in Criminal Justice
        - Track in Information Systems

        - Track in Information Security
    - M.S. in Cross-Disciplinary Studies
        - Concentration in Information Systems and Society
    - M.S. in National Security Affairs
        - Concentration in Cyber-terrorism and Security
- Huizenga College of Business and Entrepreneurship
    - Master of Business Administration
        - Concentration in Business Intelligence / Analytics
- College of Osteopathic Medicine
    - M.S. in Biomedical Informatics
    - M.S. in Disaster and Emergency Preparedness
        - Track in Cyber Security
- Halmos College of Natural Sciences and Oceanography
    - Graduate Certificate in Computational Molecular Biology
- Shepard Broad College of Law
    - Joint JD/MS Program
      The program allows J.D. students at NSU's College of Law who are also admitted to an M.S. program at the College of Engineering and Computing to count up to 9 credits of J.D. course work as electives toward their M.S. programs. Similarly, the College of Law will provide elective credit toward the J.D. from the M.S. curriculum (as per College of Law policy).

Student Organizations

Organizations with active CEC affiliations include:

- Association for Computing Machinery (ACM)
- Association for Information Systems (AIS)
- Institute of Electrical and Electronics Engineers (IEEE) and the IEEE Computer Society
- Upsilon Pi Epsilon (UPE) International Honor Society for the Computing and Information Disciplines

The goal of these organizations is to help students advance in their professions through contact with working professionals, participation in conferences, or recognition of academic excellence. Student membership provides benefits such as technical publications, career development, and financial services.

Student government: The College of Engineering and Computing Student Government Association (CEC-SGA) provides exceptional students the opportunity to be elected to represent the college on all matters pertaining to students, and is officially chartered to speak on behalf of the student body to the university administration. The mission of the CEC-SGA is to represent the students of the College of Engineering and Computing, promote advocacy and service to the institution and community at large. Elections for CEC-SGA occur at the beginning of summer term, and elected members are announced by the start of fall. The Executive Cabinet consists of the President, Vice President, Vice President of Online Affairs, Treasurer and Secretary. There are two Representatives; one Master's Representative and one Doctoral Representative.

Library Resources

The university's library system (www.nova.edu/library) is composed of the following four libraries: the Alvin Sherman Library, Research, and Information Technology Center; the Health Professions Division Library; the Shepard Broad Law Library and Technology Center; and the William S. Richardson Oceanography Library. The NSU libraries' online catalog, NovaCat, is accessible to students and faculty members wherever they may be located. NSU libraries provide access to more than 500 subscription

databases and provide online access to a variety of full-text resources including 20,000 unduplicated full-text journals, over one million dissertations, 100,000's of ERIC ED documents, and over 100,000 ebooks. Students are able to obtain books and periodicals quickly and efficiently, and have access to more than 10 million books through NSU's libraries and agreements with other libraries.

Students may request delivery of books and other documents to their homes or offices. Requests can be made via online forms or fax through Alvin Sherman Library's Document Delivery Department. Delivery options include:

- **Shipped Delivery:** requested items are shipped to the address listed in the student's ILLiad account. Materials may not all arrive to you on the same day. Library staff ship the items as they are ready. Print materials sent to students in the United States are sent by first-class mail. Print materials sent to international students are sent via DHL when necessary.
- **Electronic Delivery:** the DD/ILL Department now provides desktop delivery of articles to distance patrons. Through ILLiad we are able to post articles to a web site while simultaneously sending an e-mail notification to the patron. Users can select this mode of delivery in their ILLiad user account.
- **Other Options:** some of the databases found online in the NSU's Electronic Resources include the full text of newspaper and journal articles. A growing number of these databases can also provide full images of articles (pictures and graphs, along with text). See the complete list of databases. To determine whether a particular journal is available full text online, use Journal Finder.

The Document Delivery Department can be reached toll-free phone, email, or via the web. Students can request up to 50 free documents per week while they are enrolled at NSU. The website provides more information about the department: http://sherman.library.nova.edu/sites/services/docdel/

Students also may call the Alvin Sherman Library's Reference Desk at 800-541-6682, ext. 24613 for reference information, advice on research strategies and resources, and suggestions on other library resources that may be of use. The desk is staffed 86 hours per week. Students may ask questions via phone, email, chat, text, and set up individual consultation appointments: http://www.nova.edu/library/main/ask.html

The college provides orientations for its new students before the start of their first term. Each orientation includes an introduction to library resources and pointers to where to get additional help. Librarians also provide course specific instruction and online library workshops. For a list of upcoming and recorded workshops visit: http://sherman.library.nova.edu/sites/library-workshops/

The university's library system supports the larger community. For example, the Alvin Sherman Library, Research, and Information Technology Center is a joint-use facility with the Broward County Board of County Commissioners. This five story, 325,000 square-foot has 1,000 user seats, 20 electronic classrooms, and the 500-seat Rose and Alfred Miniaci Performing Arts Center.

Disabilities and ADA

NSU complies with the Americans with Disabilities Act (ADA). The university's detailed policy on disabilities is contained in NSU's *2014–2015 Student Handbook.* Student requests for accommodation based on ADA will be considered on an individual basis. Students with disabilities should discuss their needs with NSU's ADA Coordinator (see http://www.nova.edu/disabilityservices/) before the commencement of classes if possible.

Program Formats

M.S. and Graduate Certificate Programs

The master's degree requires 36 credit hours (12 courses or 10 courses and a thesis). Graduate certificates each require 15 credit hours. Full-time on-campus and online students may be able to complete the M.S. degree in 12 months. Part-time on-campus and online students may complete the degree in 16–24 months. On-campus programs are offered in the evening—each class meets one night a week. There are three master's terms each academic year: Fall (16 weeks), Winter (16 weeks) and Summer (14 weeks) (see page ii, Academic Calendars, for detailed schedules). On-campus students are permitted to take online courses, and online students are permitted to take on-campus courses. The college's master's students in some programs may apply for early admission into a Ph.D. program, which provides the opportunity to earn the doctorate in a shorter time. Each student must have an active broadband account with an Internet Service Provider (ISP) and must have his or her own personal computer.

Admitted students are able to take courses in either format (online or on-campus). Students participate in online classes from anywhere in the world where Internet access is available. On-campus classes are held on the main campus in Fort Lauderdale, which in a few cases are video-broadcast to classrooms at other NSU campuses (in Florida). Each class meets once a week from 6:00 p.m. to 8:00 p.m. ET for 16 weeks in the fall and winter terms and 14 weeks in the summer term. Most degree programs include an optional six-credit thesis (the six credits for thesis are in lieu of course credit hours).

CEC students are provided NSU computer accounts but must obtain their own Internet service providers and use their own computer systems. Online students use the web to access course materials, announcements, email, distance library services, subscription library databases, and other information, and for interaction with the faculty and fellow students. Online, interactive learning methods are based on the use of a web-based course management system. Online activities facilitate frequent student-to-faculty and student-to-student interaction. They are supported by threaded discussion boards, white boards, web and video conferencing, chat rooms, email, and multimedia presentations.

Ph.D. Programs

The college offers a unique Ph.D. program format, called the *cluster format*, that includes a blend of on-campus and online activities. While taking courses, students attend four cluster sessions each year over an extended weekend (Friday and Saturday) at the university. Terms are 16 weeks long and there are two terms for course work each year, beginning in August and January. A 14-week summer term offers a limited selection of courses. All terms are used by students registering for dissertation or one of the Doctoral Research sections.) Cluster weekends bring together students and faculty for participation in classes, seminars, poster sessions, and dissertation counseling, and provide ample opportunity for student-faculty and student-student interaction. Students are required to attend all of their scheduled class sessions. Between sessions, students work on course assignments and research, and participate in online activities that facilitate frequent interaction with the faculty and with other students.

Interactive learning methods, consistent communication between faculty and students, and accessible learning resources provide a powerful and supportive learning environment that can be accessed anywhere around the globe. Online activities may include forums using threaded discussion boards, chat rooms, white boards, email, and multimedia presentations. Each student must have an active broadband account with an Internet Service Provider (ISP) and must have his or her own personal computer.

The student enters doctoral candidacy upon completion of (1) course requirements with a cumulative GPA of at least 3.25 through eight 700-level courses, (2) at least two registrations of Doctoral Research, and (3) a dissertation idea approved by the student's dissertation advisor and two readers. When all conditions are met, the student becomes a candidate, the advisor and readers become the candidate's dissertation committee, and the student registers for dissertation to begin working on the dissertation proposal. The student registers for one year (three terms) of dissertation, at eight credits per term. Students who have not

completed the dissertation after one year of dissertation registrations must register for Continuing Dissertation, three terms per year, until they have satisfied the dissertation requirement. Students not on approved leave register for each term following the one in which they enter candidacy until the dissertation has been completed. Doctoral residence is defined as continuous enrollment for three consecutive terms at eight credit hours per term.

Financial Information

Tuition and Fees

Academic, program, and online services are provided only to CEC students who are currently registered. Students who are not registered are not entitled to receive services. Textbooks are not included in tuition and fees and must be purchased by the student. Students are responsible for their own lodging and travel expenses. Students must be registered to gain access to NSU's computing services. Rates are subject to change.

Application Fee	$50 nonrefundable
M.S. and Grad. Cert. Tuition (2015–2016)	$725 per credit hour
Ph.D. Tuition (2015–2016)	$1025 per credit hour
Student Services Fee (per term)	$150 (3 credit hours or less); $300 (over 3 credit hours)
Registration Fee	$30 nonrefundable
Late Registration Fee	$100 nonrefundable
Readmission Fee	$50 nonrefundable
Degree Application Fee	$100

Responsibility for Payment of Tuition and Fees

Once registered, students are personally responsible for the payment of their tuition and fees. Returned checks, cancelled credit cards, employer or agency refusal to pay, ineligibility for financial aid, and other reasons for non-payment may result in a direct bill to the student, and/or referral to a collection agency.

Payment and refund policies are based on the view that a student registering for a class is reserving a place in that class and that tuition and fees cover the opportunity to secure that place in the class. Since no other person can purchase that place, the student is responsible for the tuition and fees associated with it. Simply not attending does not constitute a reason for non-payment.

Financial Aid

The Office of Student Financial Assistance administers the university's financial aid programs of grants, loans, scholarships, and student employment and provides professional financial advisors to help students plan for the most efficient use of their financial resources for education. In order to participate in financial aid programs, a student must be admitted into a university program and must be a citizen, a national, or a permanent resident of the United States, or be in the United States for other than a temporary purpose. A prospective student who requires financial assistance must apply for financial aid while he or she is a candidate for admission. Applicants and prospective students may apply for financial aid online at http://www.nova.edu/financialaid/. Students must work directly with the university's Office of Student Financial Assistance because the school's program office does not administer or manage the financial aid process. For additional information or application forms (1) call 954-262-3380 or 800-806-3680; or (2) send email to finaid@nova.edu. To continue financial aid, at a minimum, enrolled students must demonstrate satisfactory academic progress toward a stated educational objective in accordance with the university's policy on satisfactory progress for financial aid recipients. See http://www.nova.edu/sap.

Tuition Payment Options

Tuition and fees may be satisfied with payment by check, money order, credit card, or official financial aid award letter with associated financial aid documentation. Cash will not be accepted as payment for

tuition and fees unless paid at the Office of the University Bursar. All postdated checks or credit card authorizations will be held by the university for processing until the due dates specified in this policy.

The tuition payment options are subject to change at any time at the discretion of the administration of Nova Southeastern University. The options available for the payment of tuition are:

1. *Full payment by the student* Full payment of tuition and fees is to be made at the time of registration. Registration after the registration period, when permitted, will involve payment of a late fee.
2. *Installment payment by the student* (foreign students attending on a visa may not be eligible for this option) Please see the Office of the University Bursar for more information.
3. *Direct payment by the student's employer* If a letter of commitment or a voucher from the student's employer accompanies the registration form, then the student will not be required to make a payment at registration time. The letter of commitment or the voucher must indicate that the employer will remit full payment of tuition and fees to Nova Southeastern University on receipt of the invoice from the university's accounts receivable office.
4. *Tuition reimbursement by the student's employer* If the student submits a letter from the employer at registration time that establishes eligibility for tuition reimbursement, the student may choose a two-payment plan. The first payment, due at registration, shall include all fees, 50 percent of the tuition, plus a $75 deferment fee. The second payment, due five weeks after the end of the term, shall equal 50 percent of the tuition. To secure this plan, the student must provide, at registration, a postdated check or credit card authorization for the deferred portion.
5. *Financial aid award* Students who have applied for financial aid and have submitted all the required paperwork to the Office of Student Financial Assistance may register without payment.

Admission

Admission is competitive; consequently, applicants who meet the minimum requirements specified herein are not assured admission. The college qualitatively and quantitatively evaluates applicants and makes selections based on performance, personal qualifications, and evidence of potential for success. Newly admitted students must begin the program in the term to which they were admitted. An appeal to defer matriculation for one or two terms is possible. For students who do not begin the program per their offer of admission or deferment, the offer is withdrawn; subsequent enrollment will require a new application. Applicants must meet the requirements specified below and must also satisfy the program-specific admission requirements contained in the individual program sections of this catalog. For instructions on applying, visit the college's admissions page: http://cec.nova.edu/admissions/.
For additional information, contact:

College of Engineering and Computing
Nova Southeastern University
3301 College Avenue, Carl DeSantis Building, 4th Floor
Fort Lauderdale, Florida 33314-9918

800-986-2247 or 954-262-2001
Email: cecinfo@nova.edu
Website: cec.nova.edu

Admission Information and Minimum Requirements (M.S. and Graduate Certificate)

Admission decisions are made on a rolling basis. Applications will be reviewed by the Admissions Committee after the following items have been received by the admissions office: application form, application fee, résumé, and all transcripts (unofficial copies are acceptable pending receipt of official transcripts). Applicants not having an immediate degree objective are welcome to apply for master's-level courses (see section Admission of Non-Degree Students).

1. Typically accepted applicants have earned a bachelor's degree with a GPA of at least 2.5 from a regionally accredited institution and with an appropriate major (see program-specific admission requirements under individual programs). In addition, the applicant must have earned a GPA of 3.0 in

the major. Lower GPA scores must be accompanied with a supplemental letter explaining why the low GPA does not reflect inadequate potential for success in the program.

2. Online application form and application fee.
3. Sealed official transcripts of all undergraduate and graduate education.
4. A résumé.
5. Proficiency in the English language. (See the section Writing Skills and Form and Style Requirements.) Applicants who are unable to write correctly and clearly are urged to seek remedial help before enrolling in any of the school's programs.

The college may request additional documentation to support the application. In addition, applicants may submit standardized test scores or any additional documentation to strengthen the application.

Admission Information and Minimum Requirements (Ph.D. Program)

Applications will be reviewed by the Admissions Committee after the following items have been received by the admissions office: application form, application fee, essay, curriculum vitae, three evaluation forms, and all sealed official transcripts (unofficial copies are acceptable pending receipt of sealed official transcripts). To ensure evaluation for the desired starting term, applications and all required documents must be received by the deadlines specified on the college's website (see below). Late applications that cannot be processed in time for the desired starting term will be considered for the next term.

1. An earned master's degree with a GPA of at least 3.25 from a regionally accredited institution and with an appropriate major (see program-specific admission requirements under individual programs). Alternatively, CEC master's degree students may apply for early admission into the Ph.D. program with a suitable major (see earlier section of this catalog for requirements).
2. Online application form, application fee, and two essays.
3. Sealed official transcripts of all graduate and undergraduate education.
4. Evaluation forms from three people who are familiar with your academic and/or professional capabilities and able to assess your intellectual abilities, maturity, and motivation. Forms from your professors are preferred. Forms are unacceptable if they are from family members, friends, those without experience in the research-based doctorate, or from those unable to evaluate your academic potential to succeed in the program to which you are applying.
5. A curriculum vitae (CV) that provides a short account of your academic background and professional experience.
6. Proficiency in the English language. Ph.D. students are expected to write numerous papers and a dissertation. Grammatical errors, spelling errors, and writing that does not express ideas clearly will affect a student's grades and the completion of his or her degree. The faculty will not provide remedial help concerning grammatical errors or other writing problems. Applicants who are unable to write correctly and clearly are urged to seek remedial help before applying to any of the college's programs.

The college may request additional documentation to support the application.

Additional Admission Requirements for International Students

1. The applicant must have a university-level education equivalent to a regionally-accredited United States bachelor's or master's degree in a related field (see program-specific admission requirements in this catalog) with an equivalent GPA meeting the stated minimum. A course-by-course evaluation with a GPA calculation is required. To enable CEC to determine equivalencies, applicants must have their degrees evaluated by an agency that is a member of the National Association of Credential Evaluation Services (NACES). For current information on evaluation agencies visit www.naces.org/members.htm.
2. Applicants whose native language is not English are required to demonstrate English proficiency. The following standardized tests satisfy the university's English requirement for nonnative English

speakers: (1) Test of English as a Foreign Language (TOEFL) (www.ets.org/toefl): 550 on the paper-based test, 213 on the computer-based test, or 80 on the Internet-based test; (2) International English Language Testing System (IELTS) (www.ielts.org): 6.0 on the test module; and (3) Pearson Test of English – (PTE-Academic) (www.pearsonpte.com/register): 54 on the computer-based test. Official test results must be sent directly from the testing agency to Nova Southeastern University. Proof of English language competency can also be in the form of successful completion of a degree at an approved U.S. institution of higher education, passing Academa II Level at Talk International Language School, or if your official transcript evaluation report states that your degree was completely taught in English.

3. Applicants for the M.S. or Graduate Certificate programs may completely their degrees entirely online and do not have to travel to the United States.
4. Unless pursuing a degree entirely online, pursuant to U.S. Citizenship and Immigration Services (USCIS) regulations, international students who are granted full admission to an M.S. or Ph.D. program will require an I-20 in order to obtain a student (F-1) visa for study in the U.S. for the length of their programs. Detailed instructions on how to obtain the I-20 Form, how to enter the United States with an F-1 visa, and how to maintain F-1 status are provided on the website of the Office of International Students and Scholars: www.nova.edu/internationalstudents. Applicants may contact the university's Office of International Students and Scholars by email: intl@nova.edu; telephone: 954-262-7240 or 800-541-6682, ext. 27240; or fax: 954-262-3846. An I-20 cannot be issued to a non-degree, graduate certificate, or provisionally admitted student. Interested international applicants should contact the university's Office of International Students and Scholars.
5. The application fee must be in U.S. dollars.

Provisional Admission

Students are provisionally admitted based on a review of unofficial transcripts or other specific program admission requirements. This admission, however, includes a condition that final and official documents and requirements must be received within 90 calendar days from the start of the term. If these final and official documents and/or requirements are not received by that time, the student will not be allowed to continue class attendance. Financial aid will not be disbursed to a provisional student until he or she has been fully admitted as a regular student (all admission requirements have been approved by the Office of Admissions).

Early Admission into the Ph.D. Program

(See options in individual M.S. program sections.)

This option provides the college's M.S. students in Computer Science, Information Security, and Management Information Systems the opportunity to earn the Ph.D. in a shorter time. Minimum requirements for early admission are the completion of at least 24 credits in the M.S. program with a GPA of 3.5 or higher and the completion of specific master's courses (see master's program sections for details). If admitted into the Ph.D. program, students will take the remaining 12 credits for the M.S. degree in the Ph.D. program. Master's students may apply for early admission no sooner than during the term in which they will be completing 24 credits. The application for early admission must be submitted to the Office of Admissions and must include the items listed under the Minimum Admission Requirements section for the Ph.D. program (the Office of Admissions will supply the Admissions Committee with the student's current transcripts). The applicant is encouraged to request evaluation forms from CEC professors familiar with his/her academic capabilities and potential. Upon successful completion of 12 credits in the Ph.D. program, the student may apply for the master's degree (contact the program office for a degree application).

Readmission

Any student who has been withdrawn or dismissed and wishes to continue in the program must apply for readmission, where the application is to restart the program not before one year since withdrawal or dismissal. The application for readmission must be submitted to the Office of Admissions and must include the items listed in the minimum admission requirements. The applicant, in a separate letter, must present the reasons why the conditions that led to dismissal or withdrawal have been remediated and why the applicant now feels more confident about succeeding. The applicant need only send transcripts not previously submitted. If readmitted, the student must meet all program requirements in effect at the time of readmission and will be given a new time limit.

Admission of Non-Degree Students (M.S. Only)

M.S. applicants may take courses without having an immediate degree objective. An applicant requesting non-degree status must have an earned bachelor's degree in a related field from a regionally accredited college or university and must submit an application form, official transcripts of undergraduate and graduate education, résumé, and an application fee.

Non-degree students may take up to 18 credits and must maintain a 3.0 GPA to continue enrollment with non-degree status. The non-degree student may submit a petition to the Admissions Office for a degree status change at any time. Satisfactory completion of courses by non-degree students does not guarantee admission to a master's degree program. Courses completed while the student is in a non-degree status will be evaluated as to the suitability of their transfer into the desired master's degree program. Courses applied to a graduate degree or certificate must fall within the time frame specified for the program. Non-degree students are not eligible for financial aid or for an I-20.

Academic Policies and Regulations

Writing Skills and Form and Style Requirements

Students must demonstrate proficiency in the use of the English language. Writing, including grammatical errors and spelling errors, that fails to express ideas clearly will affect their grades and the completion of their academic programs. The faculty will not provide remedial help concerning grammatical errors or other writing difficulties. It is the student's responsibility to proofread and edit his or her work, which, in both form and content, should be letter-perfect. Work that is not properly edited will be rejected.

For an individual course, the course professor will specify form and style requirements in the course syllabus. For the M.S. thesis, students must follow the guidance of their thesis advisors. Ph.D. students must follow the policies, procedures, and formatting requirements contained in the school's *Dissertation Guide* (2013) for the planning and preparation of the dissertation, as well as the guidance of their dissertation advisors. M.S. and Ph.D. students may find the *Dissertation Guide* helpful in the preparation of other work.

Several books contain general guidelines for form, style, and writing. *On Writing Well* (Zinsser, 2006) is an excellent guide to clear, logical, and organized writing. *The Elements of Style* (Strunk & White, 2000) is a compact handbook on the basic principles of composition, grammar, word usage and writing style. The *Publication Manual of the American Psychological Association* (APA) (2010), a comprehensive handbook on writing for publication, addresses editorial style, grammar, and organization. Give particular attention to Chapter 2, Manuscript Structure and Content; Chapter 3, Writing Clearly and Concisely; and Chapter 4, The Mechanics of Style. Chapter 3 also has good advice on writing style and grammar. Another excellent handbook on writing for publication is *The Chicago Manual of Style* (2003). The APA manual and the Chicago manual contain guidance on punctuation, spelling, capitalization, abbreviations, quotations, numbers, statistical and mathematical material, tables, figures, footnotes, appendixes, and reference citations in text. Students should use a good dictionary such as *Merriam-Webster's Collegiate Dictionary* (11th ed.).

Standards of Academic Integrity

For the university-wide policy on academic standards, see the section Code of Student Conduct and Academic Responsibility in NSU's *2014–2015 Student Handbook.* Also see the section Student Misconduct in this catalog. Each student is responsible for maintaining academic integrity and intellectual honesty in his or her academic work. It is the policy of the college that each student must:

- Submit his or her own work, not that of another person
- Not falsify data or records (including admission materials and academic work)
- Not engage in cheating (e.g., giving or receiving help during examinations; acquiring and/or transmitting test questions prior to an examination; or using unauthorized materials, such as notes, during an examination)
- Not receive or give aid on assigned work that requires independent effort
- Properly credit the words or ideas of others according to accepted standards for professional publications (see the next section *Crediting Words or Ideas*)
- Not use or consult paper writing services, software coding services, or similar services for the purpose of obtaining assistance in the preparation of materials to be submitted for course assignments or for theses or dissertations.
- Not commit plagiarism (*Merriam-Webster's Collegiate Dictionary* (2003) defines plagiarism as "stealing or passing off ideas or words of another as one's own" and "the use of a created production without crediting the source.") (see *Crediting Words or Ideas* below)

Crediting Words or Ideas

When using exact words from another work, quotation marks must be used for short quotations (fewer than 40 words), and block quotation style must be used for longer quotations. In either case, a proper citation must also be provided. *Publication Manual of the American Psychological Association, Sixth Edition,* (2010, pp. 170–173) contains standards and examples on quotation methods.

When paraphrasing (summarizing, or rewriting) words or ideas from another work, a proper citation must be provided. (*Publication Manual of the American Psychological Association, Sixth Edition* (2010) contains standards and examples on citation methods (pp. 174–179) and reference lists (pp. 180–224).) The *New Shorter Oxford English Dictionary* (2007) defines paraphrase as "A rewording of something written or spoken by someone else, esp. with the aim of making the sense clearer…". Changing word order, deleting words, or substituting synonyms is not acceptable paraphrasing—it is plagiarism, even when properly cited. Rather than make changes of this nature, the source should be quoted as written.

Original Work

Assignments, exams, projects, papers, theses, dissertations, etc., must be the original work of the student. Original work may include the thoughts and words of others, but such thoughts or words must be identified using quotation marks or indentation and must properly identify the source (see the previous section *Crediting Words or Ideas*). At all times, students are expected to comply with the school's accepted citation practice and policy. The college and its faculty are committed to maintaining high standards of academic integrity. Student work will be routinely submitted to plagiarism detection tools (such as those at www.turnitin.com) for review.

Work is not original when it has been submitted previously by the author or by anyone else for academic credit. Work is not original when it has been copied or partially copied from any other source, including another student, unless such copying is acknowledged by the person submitting the work for credit at the time the work is being submitted, or unless copying, sharing, or joint authorship is an express part of the assignment. Exams and tests are original work when no unauthorized aid is given, received, or used before or during the course of the examination, reexamination, or remediation.

Orientation and Advisement

New master's and graduate certificate students are provided a video-conferenced orientation (live and archived) that includes an overview on NSU's online tools as well as library access and resources. Advisement is provided by the program office and the faculty.

New Ph.D. students must attend an online orientation several weeks before the start of the term, as well as a welcome meeting on the main campus in Fort Lauderdale at their first cluster. The orientation includes an introduction to the relevant resources such as college personnel, library services, and financial aid, as well as a reminder about academic integrity. Students are offered dissertation counseling throughout the program. Advisement is provided by the program office and the faculty.

Registration

Registration information is posted on the college's website. Students can register and confirm their registration status by accessing NSU SharkLink (sharklink.nova.edu). Students are expected to register during the published registration period; note that registration is not permitted until all outstanding charges and fees have been filed. Registration after the close of the published registration period, when permitted, will incur a late fee.

The registration process begins when NSU sends an email to students' school email accounts informing them of registration for the upcoming term. Registration materials are available on the school's website. Students can confirm their registration status by accessing NSU SharkLink (sharklink.nova.edu). Students are expected to register during the published registration period. Registration after the close of the published registration period, when permitted, will require the payment of a late fee.

Drop/Add Period

Registered students may drop/add a course prior to the first day of the term and up to and including the sixth calendar day of the term (the drop/add period) without penalty. If a course is dropped between the first day of the term and the end of the drop/add period and another course is not added in its place, the withdrawal policy applies.

Refund Policy Regarding Withdrawals

(See the section Grade Policy Regarding Withdrawals.)

A student withdrawing from a course may be eligible for a refund (full or partial) of tuition paid (not including fees) depending on the date of withdrawal. Course withdrawal requests must be submitted to the program office in writing (via postal mail or email) by the student. Withdrawals sent by email must be sent from the student's assigned NSU email account and must clearly identify the student. Requests for withdrawal must be received by the program office by the withdrawal deadline date for that term. (See Academic Calendar on page ii). The amount of refund, if any, will be calculated as a percentage of the course tuition, as published on the school's website. If a student is using one of the payment plans (see section Tuition Payment Options) the tuition due or the amount refunded will be adjusted accordingly.

Auditing a Master's Course

To audit a master's course, students must request permission from the program office. Audited courses will appear on the transcript with the grade of AU. An auditor may attend classes, submit assignments, and take examinations but will receive no credit for auditing a course. Registered students may change from credit to audit status or audit to credit status during the drop/add period. A previously audited course may be taken for credit at a later date. Also, a student may audit a course previously taken and passed. Persons may not attend a class without being properly admitted to the university and registered in the class. Tuition and fees apply to all audited courses.

Independent-Study Basis and Taking a Course in Another Program

Each of these requires the student to submit a request for approval to the appropriate department chair prior to registration. *Independent-study basis* means taking a course that is published in the curriculum of the program under which the student is enrolled but is not currently offered (it would be taken under the supervision of a faculty member). The student would register for the course prefix and number listed in the curriculum. *Taking a course in another program* means taking a course in one of the school's programs in which the student is not enrolled. For each of these cases, the department chair will review the student's record to determine the appropriateness of the request. If the request appears to be consistent with the student's program and school policies, the chair will consult with the appropriate faculty member for possible approval and will notify the student of the decision and any requirements.

Attendance Policy

Students are required to be present at each meeting of their classes on campus. Exceptions to this rule may be made in the case of illness or in other hardship situations when approved by the course professor. Students should advise their course professors in advance of any anticipated absences. Additional work may be required by a course professor for any absence. Excessive absences will result in a failing grade. For online and hybrid courses, participation/attendance policies will be covered in the syllabus of each course. In particular, each course requires substantial participation in the first week of each term.

Student Research Involving Human Subjects

All students must be aware of the university's policy regarding research involving human subjects. The instruments and protocols of surveys, interviews, tests, or any other types of assessments involving human subjects must be reviewed in advance by the university's Institutional Review Board (IRB). The purpose of the IRB is to protect the rights of human subjects involved in research and ensure appropriate practices are being carried out at NSU. CEC has a representative to the IRB who can help students with the review process. There are three levels of review: exempt, expedited, and full review. The CEC representative guides students regarding the level of review required and assists with any paperwork and procedures that might be required. Most research at CEC involving human subjects falls into the exempt category, which requires a rather simple process, but it must be logged appropriately. Doctoral students doing such research should contact the CEC IRB representative by the time they start working on their dissertation proposals. Additional information can be found at http://www.cec.nova.edu/irb.html.

Courses also may involve human subject research. In most cases, faculty members secure approval in advance for all students in the course. Students planning to conduct human subject research in a course should raise the matter with their professor. Students may obtain additional information from the program office and from www.nova.edu/irb.

Student Participation in Extracurricular Research

Research is a critical component in maintaining the quality of educational programs. Research may require the collection of data from human subjects. Students may be requested by faculty to participate as human subjects in research activities. The NSU Institutional Review Board (IRB) has established procedures to ensure that all research involving human subjects complies with applicable federal laws and regulations. An important consideration in obtaining IRB approval of research is the protection of the privacy of the human subjects participating in the study. While most research studies are designed to offer some level of privacy protection to the participants, the complete anonymity of the participants cannot be guaranteed in all research activities conducted at NSU. However, a primary protection provided by the IRB process is that no researcher may involve individuals as subjects in research without their informed consent. CEC students are advised that while their participation in these research activities is extremely valuable to the researchers conducting these investigations, their participation is strictly voluntary. No CEC student will be required to participate in any research activity that is conducted outside the scope of established course

activities. Students are encouraged to discuss the scope and requirements of any research program with the principal investigator prior to volunteering to participate in the research activity. Any questions regarding the IRB can be directed to the CEC IRB representative.

Thesis Option

(Applicable to programs that support a thesis.) For the thesis option, students must register twice for 699 for a total of six credit hours. These credit hours are in lieu of six credit hours of course work (usually electives). Students who have not completed the thesis by the end of the second thesis registration must register for continuing thesis. Students interested in the thesis option should contact the program office to make arrangements.

The Dissertation

Students will have qualified for doctoral candidacy and be permitted to register for Doctoral Dissertation after they have completed their required course work with a minimum cumulative GPA of 3.25, completed at least two sections of Doctoral Research, and submitted a dissertation idea approved by a faculty advisor and two readers. Three registrations of Doctoral Dissertation are required, to be taken over three consecutive terms. The dissertation is the most important requirement for the Ph.D. Each student is expected, with the approval of a faculty advisor, to select an appropriate topic of sufficient scope to satisfy the requirements for the dissertation. Although registration for Doctoral Dissertation cannot occur until doctoral candidacy is established, students are encouraged to learn about the dissertation process as early as possible and to begin talking with faculty members about potential research topics early in the program. The dissertation must be an original work and must represent a significant extrapolation from a base of solid experience or knowledge in the student's area of concentration. Dissertation results must, in a significant way, advance knowledge, improve professional practice, or contribute to understanding in the field of study. Results must be of sufficient strength to distill from the work a paper worthy of publication in a major journal. Although publication is not a requirement for completing the Ph.D., students are encouraged to submit their dissertation research for publication. Ph.D. students must follow the policies, procedures, and formatting requirements contained in the *Dissertation Guide* (http://cec.nova.edu/documents/diss_guide.pdf). Students are required to present an oral defense of the dissertation.

Grading System

Students will be assigned grades for courses and projects according to the following system:

Grade	Grade Points
A	4.0
A–	3.7
B+	3.3
B	3.0
B–	2.7
C+	2.3
C	2.0
C–	1.7
F	0.0
I	A temporary grade assigned for incomplete course work. See the section The Temporary Grade of Incomplete (I).
W	Withdrawn from course. See the section Grade Policy Regarding Withdrawals.
PR	Progress. May be assigned to thesis, dissertation, or research registrations. Carries credit hours but no grade points. Indicates progress toward completion of a thesis or dissertation.
NPR	No Progress. May be assigned to thesis, dissertation, or research registrations. Carries no credit hours. Indicates insufficient progress toward completion of a thesis or dissertation.

Repeated NPR grades will result in probation (see section Evaluation of Research Progress).

AU Audit. For students who register for a course on an audit basis (master's students only).

To determine the grade point average (GPA), divide the sum of all the grade points earned in graduate courses taken toward the graduate degree by the number of course credit hours taken toward that degree. Only those courses and projects taken toward the degree that carry grade points, except courses that have been repeated and transfer credits, are included in the computation of the GPA. The grades of I, W, PR, and NPR do not affect the GPA. With the exception of the grade of I, once a final grade in a course has been recorded by the Office of the University Registrar it can be changed only in cases of computational error or other justifiable cause approved by the dean (see Challenge of Course Grade). A student may not do additional work nor repeat an examination to raise a final grade.

The Temporary Grade of Incomplete (I)

The temporary grade of Incomplete (I) will be granted only in cases of extreme hardship. Students do not have a right to an Incomplete, which may be granted only when there is evidence of just cause. A student desiring an Incomplete must submit a written appeal to the course professor at least two weeks prior to the end of the term. In the appeal, the student must: (1) provide a rationale; (2) demonstrate that he/she has been making a sincere effort to complete the assignments during the term; and (3) explain how all the possibilities to complete the assignments on time have been exhausted. Should the course professor agree, an *Incomplete contract* will be prepared by the student and signed by both student and professor. The Incomplete contract must contain a description of the work to be completed and a timetable. The completion period should be the shortest possible. The completion date will not typically extend beyond 30 days from the last day of the term for master's courses or 60 days from the last day of the term for doctoral courses. The Incomplete contract will accompany the submission of the professor's final grade roster to the program office. The program office will monitor each incomplete contract. When the incomplete contract ends the course professor will assign a grade based upon the work completed. No student may graduate with an I on his or her record. The grade of I does not apply to master's thesis or doctoral dissertation registrations.

Grade Policy Regarding Withdrawals

Course withdrawal requests must be submitted to the program office in writing by the student. Requests for withdrawal must be received by the program office by the withdrawal deadline (see specific withdrawal deadline dates in the Academic Calendar on p. ii). Withdrawals sent by email must be sent from the student's assigned NSU email account. Requests for withdrawal received after 11:59 p.m. on the withdrawal deadline date will not be accepted. Failure to attend class or participate in course activities will not automatically drop or withdraw a student from the class or the university. Students who have not withdrawn by the withdrawal deadline will receive letter grades that reflect their performance in the course. When a withdrawal request is approved, the transcript will show a grade of W (*Withdrawn*) for the course. Students with four withdrawals will be dismissed from the program. Depending on the date of withdrawal, the student may be eligible for a partial refund (see the program sections Refund Policy Regarding Withdrawals).

Repeating a Course

See the paragraphs Academic Progress, Grade Requirements, and Academic Standing.

Unregistered Students

Students who are not registered are not eligible to receive academic services from faculty and staff members and are not eligible to receive computing, library, and other university services. Doctoral students, see also section Leave of Absence.

Student Records and Transcripts

The university maintains a system of record keeping and provides students with official grade reports and transcripts reflecting their academic progress. This system documents all official information from the time of application for admission to graduation. Official hard copies of records are maintained by the registrar's office. Records are secured via the computerized student information system in addition to back-up hard copy files. Computer files are secure and kept up to date. The registrar's office follows the American Association of Collegiate Registrars and Admissions Officers (AACRAO) guidelines for the retention and disposal of records. After the appropriate time period, hard copy files are retired to storage. Computer files are moved to historical files and permanent records are microfilmed for later reference.

To obtain an official transcript, students or graduates should visit www.nova.edu/registrar and click on Transcript Requests. Official transcripts of a student's academic record cannot be released until after all of his or her accounts, academic or nonacademic, are paid. Upon completion of a degree program at the university, students receive one transcript without charge. Any other transcripts, before or after graduation, must be specifically requested. For these, there is a fee for each official transcript requested.

Challenge of Course Grade

A student who wishes to challenge a grade assigned for an entire course must communicate with the course professor, in writing, within 15 calendar days of posting of the grade. In this communication, the student must state the reasons for requesting a change in the grade. A decision will be made by the course professor following his or her review of the appeal. If the reply is not acceptable, the student can choose to appeal, in writing, to the department chair. The chair will review the appeal and return a decision in writing. The student will not be permitted further appeal. If, however, evidence of discrimination or a violation of the student's rights is presented, then the procedure described in the section Student Grievance Procedure shall be followed. A student may neither do additional work nor repeat an examination to raise a final grade.

Student Misconduct

Students are expected to deport themselves as respectable and respectful members of the academic community. The school will not tolerate acts of academic dishonesty, or behavior that is clearly unethical, unprofessional, flagrantly disruptive, or that violates the general understanding of the proper conduct of graduate students. Committing an act of misconduct will subject the student to dismissal from the university.

Procedures for Resolving Allegations of Student Misconduct

Violations of academic standards will be examined by the Academic Review Board, which will present its findings to the dean for adjudication. Violations of conduct or supplementary standards will be handled by the Office of the Dean of Student Affairs or by the College of Engineering and Computing. Allegations of student misconduct must be made in writing to the program office by a faculty member, staff member, or student. All pertinent factors, witnesses, events, and evidence related to the alleged misconduct should be included. If the allegations constitute probable cause to proceed, the accused will be notified in writing that an inquiry will be conducted. As part of the inquiry, all pertinent documentary evidence and statements from witnesses will be assembled. The accused will be given an opportunity to provide a written response to the allegations. When misconduct is indicated beyond reasonable doubt, an appropriate sanction will be identified (see NSU's *2015–2016 Student Handbook*). A report of the findings and penalty will be provided to the accused, who may acquiesce in the penalty or may contest in writing and may also request a hearing. Failure of the accused to respond within 20 days
shall be construed as acquiescence in the report of the inquiry. If a hearing is requested, it will be conducted by the college's Academic Review Board in the case of academic violations or by the

Office of the Dean of Student Affairs in the case of non-academic violations. If, after the hearing, the accused is found guilty of misconduct, the dean of the school or the dean of student affairs will decide on the final action to be taken.

Student Grievance Procedure

This section describes the procedure for student grievances regarding academic matters other than grades. If the issue concerns the fairness of a grade the procedure described in the section Challenge of Course Grade must be followed. Grievance procedures for nonacademic disputes are contained in NSU's *2015–2016 Student Handbook*. First, the student should attempt to resolve the matter at the level at which it occurred, e.g., the appropriate faculty member or staff member. This attempt must be in writing. The student may wish to use certified mail to verify receipt of correspondence. In the correspondence, the student must present a rationale for his or her position based on factual information. The student will receive a reply from the recipient, in writing, that addresses the complaint. If the reply is not acceptable, the student is encouraged to submit the complaint, in writing, to the next higher level, usually the department chair. If the department chair is unable to resolve the complaint, he or she will notify the student and the dean of this in writing. The student may then appeal in writing to the dean of the College of Engineering and Computing who will attempt resolution. If appropriate, the dean may assign the matter to the Academic Review Board. The committee will meet, carefully review the case, hold a hearing if necessary, and make a written recommendation, including rationale, to the dean to either accept or reject the appeal, or may propose an approach to resolve the complaint. The dean will review the Academic Review Board's findings and recommendation, and will notify the student in writing of his or her decision. The dean's decision is final and cannot be appealed.

Communication by Email

Students must use their NSU email accounts when sending email to faculty and staff and must clearly identify their names and other appropriate information, e.g., course or program. When communicating with students via email, faculty and staff members will send mail only to NSU email accounts using NSU-recognized usernames. Students who forward their NSU-generated email to other email accounts do so at their own risk. CEC uses various course management tools that use private internal email systems. Students enrolled in courses using these tools should check both the private internal email system and NSU's regular email system. NSU offers students web-based email access. Students are encouraged to check their NSU email accounts and their course management email accounts daily.

Transfer Credit Policy (M.S. only)

Up to six graduate credits from a regionally accredited institution may be transferred to one of the master's degree programs. Courses proposed for transfer must have received grades of at least B. Students may request approval of transfer credits in writing at the time of application (see instruction on the application form). Copies of catalog course descriptions or course syllabi are required to process requests for transfer credits. This policy does not apply to certificate programs or to non-degree students.

Academic Progress, Grade Requirements, and Academic Standing

Students are expected to make academic progress through their programs. Relevant academic policies are as follows (also see the section Time Limitations):

The following regulations apply to M.S. and Graduate Certificate students:

- Each student must maintain a cumulative grade point average (GPA) of at least 3.0 for the duration of his or her program to remain in good academic standing. When the cumulative GPA falls below 3.0 the student is automatically placed on academic probation and will not be permitted to graduate. (Academic probation may adversely affect financial aid.) If the cumulative GPA is not

raised to 3.0 within two terms the student may be dismissed from the program. Upon achieving a cumulative GPA of 3.0, the student will be removed from academic probation. If the cumulative GPA could not possibly be raised to 3.0 within the required period the student will be dismissed.

- Students with four withdrawals will be dismissed.
- Students who receive an F grade have the right to repeat the course. Students who receive a second grade of F in any course will be dismissed (independent of whether the first F was repeated with a passing grade).
- A student who has passed a course with a grade of B or higher is not permitted to repeat it for credit. A student receiving a grade of B– or lower has one opportunity to repeat the course and earn a higher grade. Students are recommended to consult with their academic advisor before registering for a repeated course. Students may not repeat more than two courses to raise passing grades. The transcript will show both the original and repeat grades; however, only the higher grade will be counted in the computation of the student's GPA. Students repeating a course must pay course tuition and fees.

The following regulations apply to Ph.D. students:

- Students must maintain a cumulative grade point average (GPA) of at least 3.25 for the duration of their programs to remain in good academic standing. If the cumulative GPA falls below 3.25 the student will automatically be placed on academic probation. (Academic probation may adversely affect financial aid.) If the cumulative GPA is not raised to 3.25 within two terms the student will be dismissed from the program. Upon achieving a cumulative GPA of 3.25, the student will be removed from academic probation. If the cumulative GPA could not be raised to 3.25 within the required period the student will be dismissed immediately. Students who do not have a cumulative GPA of 3.25 at the end of their course work will not be eligible to enter doctoral candidacy or register for dissertation.
- Students with four withdrawals will be dismissed immediately.
- Students may repeat a doctoral course to replace the earned grade (whether it was passing or failing). At most two courses may be repeated. Students repeating a course must pay course tuition and fees.
- Students may not repeat a master's course taken to fulfill requirements specified on admission to the doctoral program.
- Students who receive two failing grades will be dismissed immediately (independent of whether the first F was repeated with a passing grade).
- Doctoral courses taken to satisfy prerequisite requirements must be completed with a grade of B or better.
- Registered but inactive dissertation students risk losing their advisors/committees, especially if their inactivity has not been coordinated with their advisors.
- Students who make sustained unsatisfactory progress toward the completion of a dissertation will be placed on probation, and are subject to dismissal (see the section Evaluation of Research Progress).

Evaluation of Research Progress (Doctoral Students Only)

(See the section Academic Progress, Grade Requirements, and Academic Standing.)

Students are evaluated regularly regarding their research progress. The purpose of such evaluations is to provide students with relevant and timely feedback concerning their overall performance in the dissertation process and to serve as a screening procedure. Failure to demonstrate adequate progress (as measured by NPR grades) in two out of three consecutively registered terms will place the student on probation. Students can remediate probation and return to good standing by (1) earning two consecutive PR grades or (2) by securing approval of the next dissertation milestone (candidacy, proposal, or report). Students who fail to remediate under either of those criteria are reviewed by the Academic Review Board for sanctions, up to and including dismissal from the Ph.D. program.

Students must demonstrate proficiency in the use of the English language in all work submitted during the dissertation process. Grammatical errors, spelling errors, and writing that fails to express ideas clearly will not be tolerated and may result in NPR grades. The faculty will not provide remedial help concerning grammatical errors or other writing problems that students might have. Students who are unable to write clearly and correctly are urged to obtain remedial help. (See the section Writing Skills and Form and Style Requirements.)

Leave of Absence (Doctoral Students Only)

Doctoral students are expected to register for courses or dissertation credits continuously from acceptance in the program until graduation. In the event of circumstances that preclude registration for course or dissertation credit, the student must apply for a leave of absence to avoid dismissal from the program. A leave application must include the reason for and expected duration of the leave. The leave should be coordinated with the student's dissertation chair, if such a relationship exists, before approval by the program director. Note that coordination with the dissertation chair does not guarantee that the dissertation committee will continue to work with the student upon the student's return.

Students may request a minimum of one term's leave. Leave requests for greater than one year are discouraged. Students may not accumulate more than six terms of leave of absence during their studies. Multiple leave extensions would be approved only under extraordinary circumstances. Students requiring long or repeated absences are recommended to consider withdrawing from the program, retaining the right to apply for readmission. (Upon readmission, completed course work may or may not count toward the degree.)

Time spent on leave **does** count toward a student's total time limit in the program.

At leave expiration, students must re-enroll or request a leave extension. Absent an approved leave extension or re-registration, students will be dismissed from the program.

To initiate a leave request, contact the program office.

Time Limitations

Students must complete requirements for the master's degree within five years from beginning the program. Students must complete certificate programs within three years from beginning the program.

Students desiring an extension of time must petition the program office in writing at least one month before the time limit is reached. Extensions may be granted only if the petition presents justifiable cause and an acceptable plan for program completion. In the absence of a petition for extension, the student will be automatically dismissed from the program. (See the sections on readmission.)

Students must complete requirements for the Ph.D. degree within 10 years from the date of their first registration.

Readmission in Advance of Dismissal for Exceeding the Time Limitation

(See also section Readmission.) Students nearing the time limit may petition the Director of Student Services for readmission in advance of dismissal by submitting a letter of justification that describes the reasons why academic potential has changed for the better. The director may request additional documentation and may request evaluations by the faculty. Readmitted students will be given a new time limit.

Independent-Study Basis and Taking a Course in Another Program

Each of these requires the student to submit a request for approval to the relevant department chair prior to registration. *Independent-study basis* means taking a course that is published in the curriculum of the

program under which the student is enrolled but is not currently offered (it would be taken under the supervision of a faculty member). The student would register for the course prefix and number listed in the curriculum. *Taking a course in another program* means taking a course in one of the school's programs in which the student is not enrolled. For each of these cases, the department chair will review the student's record to determine the appropriateness of the request. If the request appears to be consistent with the student's program and school policies, the department chair will consult with the appropriate faculty member for possible approval and will notify the student of the decision and any requirements.

Student Services

(For additional services see the NSU website and the Student Handbook.)

NSU Cards

The NSU Card is the official Nova Southeastern University identification card and each registered student is issued one. Students are required to carry and display the NSU Card for identification purposes when at the university. Cards are required to check out books from the library and for many other purposes (visit www.nova.edu/nsucard). A number of businesses in the community will give students discounted rates on a variety of services ranging from movies to dinner if an NSU card is shown. If an NSU card is lost or destroyed, a new one may be requested at the NSU Card Office. There is a fee to replace the card.

Textbooks

Book information is available online. Barnes & Noble College Bookstores, the university's official bookstore, offers comprehensive services to local and online students. While students have the option to purchase textbooks from other online and local sources, there may be benefits from purchasing from the university's bookstore (on-campus or online). The university's bookstore provides a wide range of shipping options.

The university bookstore posts book titles on its website at least one month prior to the start of each term. Students should order their books early enough to ensure delivery prior to the start of the term in the event that e-texts are not available. There may be occasions when books are not available for the start of the term because they are out of stock or temporarily out of print. In such cases, faculty members will ensure that courses progress according to their schedules. It is recommended that students order each book by its ISBN number in order to be assured of obtaining the edition required for the course.

Student Housing

The Office of Residential Life and Housing helps students find housing on- and off-campus. One- and two-bedroom furnished apartments are available for graduate students without children. For further information about on-campus and off-campus housing contact the university's Office of Residential Life and Housing at 954-262-7052 or 800-541-6682, ext. 27052.

Travel Services

Nova Southeastern University has a full-service travel agency that can make reservations, issue airline tickets, and reserve rental cars. In addition, travel agents can also help make arrangements for trips and vacations. NSU's travel agency accepts money orders and major credit cards. The travel agency can be reached at www.nova.edu/cwis/bsv/travel or via email: travel@nova.edu.

Alumni Association

Nova Southeastern University has an active alumni association. It is organized on three levels—local, state, and national—to provide special programs and other services that promote the professional and intellectual growth of graduates and maintain communications between graduates and the university. This

should be removed For information visit NSU's Alumni Association at www.nova.edu/alumni or the college's alumni office at http://www.cec.nova.edu/alumni.

Graduation

Graduation Requirements

Students must complete the minimum number of credit hours designated for the chosen program, and must meet the following requirements:

- Admission as a degree-seeking candidate in one of the programs
- Satisfaction of program requirements including completion of courses, master's thesis where appropriate and, for the Ph.D., an approved dissertation as specified in program documentation
- Ph.D. students: Attendance at all required class meetings.
- Attainment of a cumulative GPA of at least 3.0 (M.S. students) or 3.25 (Ph.D. students)
- Completion of the form *Application for Degree* and payment of the degree application fee. The *Application for Degree* form may be downloaded from the school's website or obtained from the program office or the university registrar. Master's students should complete the form at the time of registration for their final term. Doctoral students should complete the form upon written notification of acceptance of their dissertation report.
- Payment of all tuition and fees and fulfillment of all obligations to the library, the student's program, and the office of student financial services

Commencement

A commencement ceremony is held annually in May or June for Nova Southeastern University graduate students. All graduating students are encouraged to participate in this important ceremony. In order for a student to participate, the program director must expect the completion of all the student's graduation requirements within six weeks following the date of the commencement ceremony.

Students expecting to graduate must complete an application for graduation and submit it to the program office at least six weeks prior to the date of the commencement ceremony. The program office will advise the university registrar of eligible students, who will distribute commencement procedures to these students.

Department of Computer Science

Programs: B.S., Computer Science; Certificate, Web Programming and Design; M.S., Computer Science; Ph.D., Computer Science

Faculty: Michael Laszlo (Chair), Paul Kenison, Wei Li, Peixiang Liu, Greg Simco, Junping Sun, and Raisa Szabo

Undergraduate curricula are detailed in the NSU Undergraduate Catalog.

Master of Science in Computer Science

The M.S. in Computer Science is a 36 credit-hour program. It is designed to give students advanced knowledge of the field and to provide an enduring foundation for future professional growth. The program blends theory and practice into a learning experience that develops skills applicable to complex real-world problems. Its formats offer full-time students the opportunity to earn the master's degree in 12 months and working professionals the opportunity to earn the degree in 16–24 months. Students in the program may be eligible to apply for admission to the Ph.D. program before finishing the M.S.; see section Early Admission into the Ph.D. Program earlier in this catalog, and specific requirements later under the Ph.D. in Computer Science.

Graduates are able to (1) communicate computer science concepts, designs, and solutions effectively and professionally; (2) apply knowledge of computing to produce effective designs and solutions for specific problems; (3) identify, analyze, and synthesize scholarly literature relating to the field of computer science; and (4) use software development tools, software systems, and modern computing platforms.

Program-Specific Admission Requirements

(For general requirements, see the section Admission.)

This program is designed for students with undergraduate majors in computer science, engineering, mathematics, or physics, and who have completed courses or have equivalent experience in data structures and algorithms, assembly language, computer organization and architecture, programming in a modern high-level language, calculus, and discrete mathematics.

Applicants who do not have adequate backgrounds may be required to take one or more of the following 500-level graduate courses during the first two terms of the student's program:

MSIT 500 Foundations of Systems
CISC 500 Java Programming Language
CISC 501 Computer Organization and Architecture
CISC 502 Mathematics in Computing
CISC 503 Data Structures and Algorithms

These are in addition to the required 36 credit hours of courses at the 600 level. Courses at the 500 level, when required, must be completed prior to taking courses at the 600 level; however, some exceptions may be permitted by the program director. All 500-level courses must be completed with a grade of B or higher to continue in the program. CISC 500 is a prerequisite to CISC 503.

Curriculum for the M.S. in Computer Science

The M.S. in Computer Science is offered with six concentrations. Student must complete four core courses (twelve credits), one concentration (nine credits), and fifteen elective credits. Core courses, concentrations, and electives are listed below. If the thesis option is elected, students take nine credits of elective and six credits of thesis. Plans for the thesis option must be made with and approved by the program office.

Core Courses (three credits each)
CISC 610 Programming Languages
CISC 615 Design and Analysis of Algorithms
CISC 640 Operating Systems
CISC 680 Software Engineering

Theory Concentration, Courses (three credits each)
CISC 630 Compilers
CISC 631 Theory of Computation
ISEC 620 Applied Cryptography

Software Engineering Concentration, Courses (three credits each)
CISC 682 Software Requirements Engineering
CISC 684 Software Testing and Verification
Either
CISC 683 Object-Oriented Design
or
CISC 685 Interaction Design

Computer Systems Concentration, Courses (three credits each)
CISC 647 Computer Architecture
CISC 650 Computer Networks
CISC 665 Distributed Systems

Database Concentration, Courses (three credits each)

CISC 660 Database Management Systems
ISEC 640 Database Security
CISC 662 Data Mining and Knowledge Discovery in Databases

Security Concentration, Courses (three credits each). Choose three:

ISEC 600 Secure Computer Systems
ISEC 620 Applied Cryptography
ISEC 640 Database Security
ISEC 650 Computer and Network Forensics
ISEC 660 Advanced Network Security

Real-World Computing Concentration, Courses (three credits each)

CISC 665 Distributed Systems
CISC 670 Artificial Intelligence
CISC 681 Computer Graphics

Elective Courses (three credits each)

Any course in the concentrations described above is also an elective course in the program. Additionally, any offerings of CISC 690, Special Topics in Computer Science, will count as electives. Students may also petition to count other courses at the school as electives.

Ph.D. in Computer Science

This program offers a course of study leading to the degree of Doctor of Philosophy (Ph.D.) in Computer Science. Its cluster format combines traditional and online instruction to provide professionals the opportunity to pursue graduate study while continuing to work in their current positions. The program is especially well suited to those in industry, education, or government who are involved with one of the many areas of computer science and information technology. It provides research-oriented professionals with knowledge in the major areas of computer science the ability to develop creative solutions to substantive real-world problems. Each student must complete eight core courses, two research courses, and a dissertation.

A graduate with a Ph.D. in Computer Science will have the ability to: (1) acquire advanced knowledge and deeper understanding of the field of computer science; (2) communicate professionally and ethically about computer science research issues; (3) identify, analyze, and synthesize scholarly literature related to the field of computer science; and (4) generate new knowledge through research/scholarship and disseminate that knowledge to others by demonstrating the necessary technical and intellectual skills to produce a written document that makes an original contribution to the field of computer science.

Program-Specific Admission Requirements

(For general requirements, see the section Admission.)

This program is designed for the student with a master's degree in computer science, or a closely related field. In addition to holding a relevant master's degree, the applicant should satisfy graduate prerequisites or have equivalent experience in programming languages, data communications and computer networks, operating systems, compilers, database management systems, theory of computation, design and analysis of algorithms, and computer architecture. Alternatively, CEC master's students in computer science may apply for early admission into the Ph.D. program.

Requirements to Apply Early to the Ph.D. Program

This option provides the opportunity for master's students in computer science to earn the Ph.D. in computer science or computer information systems in a shorter time. In addition to the requirements specified in the section Early Admission into the Ph.D. Program, the student must have completed CISC 610 Programming Languages, CISC 615 Design and Analysis of Algorithms, CISC 630 Compilers, CISC 631 Theory of Computation, CISC 640 Operating Systems, and CISC 680 Software Engineering.

Curriculum for the Ph.D. in Computer Science

The program requires at least 64 credit hours, of which 32 are for courses and at least 32 are for research and dissertation. Courses, research, and dissertation registrations are listed below:

Core Courses (four credits each) (Select eight of these.)

CISD 700	Theory and Principles of Programming
CISD 730	Operating Systems
CISD 740	Data Communications and Computer Networking
CISD 750	Database Management Systems
CISD 760	Artificial Intelligence
CISD 770	Software Engineering
CISD 792	Computer Graphics
CISD 794	Knowledge Discovery in Databases
ISEC 730	Network Security and Cryptography

Research Registrations Students are required to complete at least two sections (four credits each) of CISD 885, Doctoral Research, before entering candidacy. Students must register for the course with a particular faculty member as directed in the course description. Students are further advised to wait until the second year of study before registering for Doctoral Research. Students will repeat Doctoral Research until securing a dissertation idea approved by the instructor and two faculty readers.

Dissertation Registrations Students must make three consecutive registrations (eight credits each) for CISD 901, Doctoral Dissertation, to total the 24 credits of dissertation required. Students whose dissertations are not completed within three registrations (one year) continue to register for CISD 920 Continuing Dissertation (four credits) each term until the dissertation is complete.

Department of Engineering and Technology

Programs: B.S., Computer Engineering; B.S., Information Technology; B.S., Software Engineering; M.S., Information Technology; M.S., Software Engineering.

Faculty: Jose Ramos (Chair), Charmaine Barreto, Vivian Haddad, Frank Mitropoulos, Saeed Rajput, Phyllis Sweeney, Michael Van Hilst

Undergraduate curricula are detailed in the NSU Undergraduate Catalog.

Master of Science in Information Technology

Information Technology spans organizational information systems, application technologies, software methods and technologies, and systems infrastructure. It focuses on meeting the needs of users within an organizational and societal context through the selection, creation, application, integration and administration of computing technologies and resources. The M.S. in Information Technology is a 36 credit-hour program. The program's formats offer full-time and working professionals the opportunity to earn the degree in 16–24 months.

A graduate with an M.S. in Information Technology will have the ability to: (1) communicate information technology concepts, designs, and solutions effectively and professionally; (2) apply knowledge of information technology to produce effective designs and solutions for specific problems; (3) identify, analyze, and synthesize professional literature relating to the field of information technology; and (4) use current technologies, tools, software systems, modern computing platforms, and apply best practices to develop real-world solutions for specific problems (e.g. applications, deployments, etc.).

Program-Specific Admission Requirements

(For general requirements, see the section Admission.)

This program is designed for students with undergraduate majors in science, math, engineering, or business. In addition, applicants must have knowledge of structured programming in a modern high-level language as well as fundamentals of computer technology. Applicants who do not have an adequate background may be required to take one or more of the following 500-level graduate courses during the first two terms of the student's program.

MSIT 500 Foundations of Systems
MSIT 501 Foundations of Programming, Data Structures, and Algorithms

Curriculum for the M.S. in Information Technology

The M.S. in Information Technology is offered with three concentrations. Student must complete four core courses (twelve credits), one concentration (nine credits), and fifteen elective credits. Core courses, concentrations, and electives are listed below. If the thesis option is elected, students take nine credits of elective and six credits of thesis. Plans for the thesis option must be made with and approved by the program office.

Core Courses (three credits each)
MSIT 630 Database Systems
MSIT 650 Platform and Network Technologies
MSIT 660 Software Development
ISEC 615 Fundamentals of Security Technologies

Application Development Concentration, Courses (three credits each)
MSIT 665 Web Services
Either
MSIT 662 Mobile Application Development in iOS
or
MSIT 664 Mobile Application Development in Android
MSIT 668 Mobile Application Development Capstone

Database Concentration, Courses (three credits each)
MMIS 671 Fundamentals of Analytics and Business Intelligence
MMIS 643 Data Mining
MSIT 638 Database Capstone

System Administration Concentration, Courses (three credits each)
MSIT 652 System Integration and Administration
MSIT 654 Database Integration and Administration
MSIT 658 System and Database Administration Capstone

Elective Courses
Students select any five 600-level courses at the college with prefix MMIS, MSIT, or ISEC except MMIS 630, 653; or ISEC 600, 620, 640, 650, 660.

Master of Science in Software Engineering

The Master of Science in Software Engineering is a 36 credit-hour program. Offered online and on-campus, the degree focuses on the foundations of software engineering, including areas such as requirements, design, development, testing, verification, human-computer interaction, and project management. The master's degree is designed to give students a thorough knowledge of the field and to provide an enduring foundation for future professional growth. The program blends theory and practice into a learning experience that develops skills applicable to complex real-world problems. Its formats offer full-time students the opportunity to earn the degree in 12 months and working professionals the opportunity to earn the degree in 16–24 months.

Graduates with the M.S. in Software Engineering are able to (1) communicate software engineering concepts, designs, and solutions effectively and professionally; (2) apply knowledge of software engineering to produce effective designs and solutions for specific problems; (3) identify, analyze, and synthesize scholarly literature relating to the field of software engineering; and (4) use software development tools, software systems, and modern computing platforms.

Program-Specific Admission Requirements

(For general requirements, see the section Admission.)

The program is designed for students with undergraduate majors in science, math, or engineering. Applicants must have knowledge of computing fundamentals, object-oriented programming, data structures and algorithms, and discrete mathematics. Applicants who do not have an adequate background may be required to take one or more of the following 500-level graduate courses during the first two terms of the student's program.

MSIT 500 Foundations of Systems	CISC 502 Mathematics in Computing
CISC 500 Java Programming Language	CISC 503 Data Structures and Algorithms

These are in addition to the required 36 credit hours at the 600 level. Courses at the 500 level, when required, must be completed prior to taking courses at the 600 level; however some exceptions may be permitted by the program office. All 500-level courses must be completed with a grade of 'B' or higher to continue in the program. CISC 500 is prerequisite to CISC 503.

Curriculum for the M.S. in Software Engineering

Core courses and electives are listed below. Students must take all six core courses and six electives. If the thesis option is elected, students take four electives plus six thesis credits. Students who wish to take an additional elective must request approval from the program office prior to registration. Plans for the thesis option must be made with and approved by the program office.

Core Courses (three credits each)
CISC 680 Software Engineering *(taken in the first term)*
CISC 682 Software Requirements Engineering
CISC 683 Object-Oriented Design
CISC 684 Software Testing and Verification
CISC 685 Interaction Design
MMIS 621 Information Systems Project Management

Electives (three credits each)
Students may select any six 600-level courses at the college with prefix CISC, MSIT, ISEC, or MMIS (except MMIS 630, 653, 656, 660, 680 or MSIT 660).

Department of Information Systems and Cybersecurity

Programs: B.S., Computer Information Systems; M.S., Information Security; M.S., Management Information Systems; Graduate Certificate, Business Intelligence / Analytics; Graduate Certificate, Information Security Management; Ph.D., Information Assurance; Ph.D., Information Systems

Faculty: James Parrish (Chair), Gertrude (Trudy) Abramson, James Cannady, Maxine Cohen, Laurie Dringus, Tim Ellis, Yair Levy, Marlyn Littman, Sumitra Mukherjee, Souren Paul, Marti Snyder, Gurvirender Tejay, Steve Terrell, Ling Wang

Undergraduate curricula are detailed in the NSU Undergraduate Catalog.

Master of Science in Information Security

This program was developed to address the rapidly growing global problems of maintaining and securing computer information. Important areas addressed by the program include threats and vulnerabilities, cryptography, authentication and access control, security models, network security, trusted computer systems, distributed systems security, Internet security, applications security, and security management and policies.

The M.S. is recognized by the National Security Agency (NSA) based on its certification of the school's curriculum for compliance with the requirements of NSA national training standards. The M.S. in Information Security is also designated by NSA for the training of Network Security Engineers. Graduates possess the necessary skills and abilities for the design of secure network infrastructures and security analysis of network traffic. As a result of this certification, Federal agencies may sponsor civilian and military personnel to take the school's certified graduate courses, and the school is authorized to issue certificates to students who complete such courses. Individuals may apply to take one or more certified information security courses as non-degree students. These programs are available online or on-campus.

The M.S. in Information Security is a 36 credit-hour program. It requires the completion of 12 courses or 10 courses and a six-credit thesis. Its formats offer full-time students the opportunity to earn the degree in 12 months and working professionals the opportunity to earn the degree 16–24 months. Students in the program may be eligible to apply for admission to the Ph.D. programs in Information Assurance or Information Systems before finishing the M.S.; see section Early Admission into the Ph.D. Program earlier in this catalog, and specific requirements later under the Ph.D. programs.

The M.S. in Information Security has also been designed to include instruction in all of the knowledge domains for the Certified Information Systems Security Professional (CISSP) certification. Completion of the M.S degree, along with the administrative requirements for the certification, prepares the graduate to take the CISSP exam. A graduate with an M.S. in Information Security will have the ability to (1) describe the primary types of access control and the potential applications of each type; (2) demonstrate an understanding of the fundamental concepts, technologies, and challenges of telecommunications and network security; (3) demonstrate an understanding of the key concepts of information security governance and risk management, including current best practices in business continuity and disaster recovery planning; (4) describe the components of effective security architecture and the various security models that can be used in the design of secure architectures; (5) possess an understanding of the major cryptographic algorithms used in information security and how each can be effectively integrated into a secure information infrastructure; (6) understand the common techniques to achieve effective physical security of protected information systems.

Program-Specific Admission Requirements

(For general requirements, see the section Admission.)

These programs are designed for students with undergraduate majors in computer science, information systems, information technology, engineering, mathematics, or physics. Applicants must have knowledge of data structures and algorithms, assembly language and computer architecture, structured programming in a modern high-level language, and discrete mathematics. Applicants who do not have an adequate background may be required to take one or more of the following 500-level graduate courses during the first two terms of the student's program.

MSIT 500	Foundations of Systems		
CISC 500	Java Programming Language	CISC 502	Mathematics in Computing
CISC 501	Computer Organization and Architecture	CISC 503	Data Structures and Algorithms

These are in addition to the required credit hours at the 600 level. Courses at the 500 level, when required, must be completed prior to taking courses at the 600 level; however some exceptions may be permitted by the program director. All 500-level courses must be completed with a grade of 'B' or higher to continue in the program. CISC 500 is prerequisite to CISC 503.

Curriculum for the M.S. in Information Security

Core courses and electives are listed below. Students must take all nine core courses and three electives. Students who wish to take an additional elective must request approval from the program office prior to registration. If the thesis option is elected, students must take all nine core courses, one elective, and six thesis credits. Plans for the thesis option must be made with and approved by the program office.

Core Courses (three credits each)

CISC 640	Operating Systems
MSIT 630	Database Systems
CISC 650	Computer Networks
CISC 680	Software Engineering
ISEC 600	Secure Computer Systems
ISEC 620	Applied Cryptography
ISEC 640	Database Security
ISEC 650	Computer and Network Forensics
ISEC 655	Information Security Governance
ISEC 660	Advanced Network Security

Electives (three credits each)

Students choose any two 600-level courses at the college prefixed RESD, MMIS, MSIT, ISEC, or CISC except MMIS 630, 653; MSIT 650, 660; or CISC 660.

Master of Science in Management Information Systems
Graduate Certificate in Business Intelligence / Analytics
Graduate Certificate in Information Security Management

The M.S. in Management Information Systems is a 36 credit-hour program. It focuses on the application of information technology to the collection, retention, and dissemination of information for management planning and decision-making. The program concentrates on areas such as project management, decision support systems, computer languages, client-server and distributed computing, database systems and data warehousing, telecommunications, system analysis and design, human-computer interaction, electronic commerce, information security, computer graphics, and multimedia.

The program blends theory and practice into a learning experience that develops skills applicable to complex real-world problems. It is designed to give students a thorough knowledge of the field and to provide an enduring foundation for future professional growth.

The program's formats offer full-time students the opportunity to earn the master's degree in 12 months and working professionals the opportunity to earn the degree in 16–24 months. Students in the program may be eligible to apply for admission to the Ph.D. program in Information Systems before finishing the M.S.; see section Early Admission into the Ph.D. Program earlier in this catalog, and specific requirements later under the Ph.D. in Information Systems program.

Students have the option to earn the M.S. in Management Information Systems following one of six concentration options, listed below. Note that the two concentrations Information Security Management and Business Intelligence / Analytics are each also available as graduate certificates, each requiring a total of 15 credit hours (five courses). The concentration and graduate certificate in Information Security Management are recognized by the National Security Agency (NSA) based on its certification of the college's curriculum under NSA national training standards. The M.S. in Management Information Systems Information Security Concentration is also designated by NSA for the training of System Security Administrators. Graduates possess the necessary skills and abilities for the secure configuration, operation and maintenance of a computer system. As a result of this certification, Federal agencies may sponsor civilian and military personnel to take the college's certified graduate courses, and the college is authorized to issue certificates to students who complete such courses. Individuals may apply to take one or more certified information security courses as non-degree students. These programs are available online or on-campus. Students who complete a concentration may also request the corresponding graduate certificate.

Graduates with the M.S. in Management Information Systems are able to: (1) communicate management information systems concepts, designs, and solutions effectively and professionally; (2) apply knowledge of management information systems to produce effective designs and solutions for specific problems; (3) identify, analyze, and synthesize scholarly literature relating to the field of management information systems; (4) evaluate software development tools, software systems, and modern computing platforms.

Program-Specific Admission Requirements

(For general requirements, see the section Admission.)

These programs are designed for students with undergraduate majors in (management) information systems, information technology, business administration, or a related field, and having knowledge and significant experience in computer applications. Students who cannot demonstrate competence in programming in a high-level language such as C, C++, or Java must take MMIS 501 Introduction to Java Programming. Students without an academic or professional background in information systems must take MMIS 520 Management Information Systems. These courses are in addition to the required 36 credit hours at the 600 level. Either required 500-level course must be completed prior to taking courses at the 600 level; however, some exceptions may be permitted by the program director.

Curriculum for the M.S. in Management Information Systems

All students, regardless of concentration, must complete four core courses per the list below. Students then either pursue the General Information Systems track (no concentration) or select one of six concentrations. For each, the required courses are listed. The student then pursues additional courses as electives to complete 36 hours at the 600 level. All options allow for at least six elective credits, which may be substituted for a thesis if desired. Plans for the thesis option must be made with and approved by the program office. Any course in the program may be used as an elective.

Core Courses (three credits each)
MMIS 621 Information Systems Project Management
MMIS 630 Database Management and Applications
MMIS 653 Telecommunications and Computer Networking
MMIS 660 Systems Analysis and Design

General IS (no concentration) (three credits each)
MMIS 627 Enterprise Technologies and Infrastructures
MMIS 654 Electronic Commerce on the Internet
MMIS 665 Information Systems Strategy
MMIS 671 Fundamentals of Analytics and Business Intelligence
ISEC 655 Information Security Governance

Business Intelligence / Analytics Concentration, Courses (three credits each)
MMIS 642 Data Warehousing
MMIS 643 Data Mining
MMIS 671 Fundamentals of Analytics and Business Intelligence
MMIS 692 Capstone Project in Business Intelligence

Web Management Concentration, Courses (three credits each)
MMIS 681 Multimedia Systems
MMIS 650 Fundamentals of Cloud Computing
MMIS 654 Electronic Commerce on the Internet
MMIS 656 Web Design Technologies
MMIS 671 Fundamentals of Analytics and Business Intelligence

Information Security Management Concentration, Courses (three credits each)
ISEC 615 Fundamentals of Security Technologies
ISEC 635 Information Security Operations Management
ISEC 655 Information Security Governance
ISEC 675 Information System Auditing
ISEC 695 Information Security Management Project

Enterprise Systems Concentration, Courses (three credits each)
MMIS 627 Enterprise Technologies and Infrastructures
MMIS 628 Enterprise Systems and Business Processes
MMIS 642 Data Warehousing
MMIS 671 Fundamentals of Analytics and Business Intelligence

Human-Computer Interaction Concentration, Courses (three credits each)
MMIS 680 Human-Computer Interaction
MMIS 623 Information Privacy and Ethics
MMIS 646 Data Visualization
MMIS 654 Electronic Commerce on the Internet
MMIS 656 Web Design Technologies

Learning Technology Concentration, Courses (three credits each)
MITE 628 Learning Design
MITE 655 Foundations of Learning Technology
MITE 661 E-Learning
MMIS 680 Human-Computer Interaction
RESD 620 Organizational Assessment and Evaluation

Electives (three credits each)
Depending on the concentration, students take two to four more courses to complete the 36-credit-hour curriculum. Courses may be drawn from any listed above as well as the following.

RESD 600 Introduction to Research Methods and Statistics
MITE 612 Authoring Systems
RESD 630 Digital Research and Academic Writing
MMIS 636 Computer-Supported Cooperative Work
MMIS 638 Computer-Mediated Communication
MITE 642 Online Communities
MMIS 644 Social Media
MITE 670 Learning Theories
CISC 684 Software Testing and Verification
MMIS 691 Special Topics in Management Information Systems

Curriculum for the Graduate Certificate in Business Intelligence / Analytics

Students must take the five courses listed below.

MMIS 671 Fundamentals of Analytics and Business Intelligence OR QNT 5040 Business Modeling
MMIS 630 Database Management and Applications
MMIS 642 Data Warehousing
MMIS 643 Data Mining
MMIS 692 Capstone Project in Business Intelligence

Curriculum for the Graduate Certificate in Information Security Management

Students must take the five courses listed below.

ISEC 615 Fundamentals of Security Technologies
ISEC 635 Information Security Operations Management
ISEC 655 Information Security Governance
ISEC 675 Information System Auditing
ISEC 695 Information Security Management Project

Ph.D. in Information Assurance

This program offers a course of study leading to the degree of Doctor of Philosophy (Ph.D.) in Information Assurance, recognized by the U.S. National Security Agency and the Department of Homeland Security. Its cluster format combines traditional and online instruction to provide professionals the opportunity to pursue graduate study while continuing to work in their current positions. The Ph.D. in Information Assurance is a comprehensive, multidisciplinary, research program that prepares graduates for key positions in academia, in federal, state and local government agencies, and in business and industry. The curriculum combines both technically intensive and management-focused security courses to provide a comprehensive approach to the study of information assurance/information security. Each student must complete eight core courses, at least two research courses, and a dissertation.

A graduate with a Ph.D. in Information Assurance will have the ability to: (1) acquire advanced knowledge and deeper understanding of the field of information assurance; (2) communicate professionally and ethically about information assurance research issues; (3) identify, analyze, and synthesize scholarly literature related to information assurance; and (4) generate new knowledge through research/scholarship and disseminate that knowledge to others by demonstrating the necessary technical and intellectual skills to produce a written document that makes an original contribution to the field of information assurance/information security.

Program-Specific Admission Requirements

(For general requirements, see the section Admission.)

This program is designed for individuals with experience in information assurance/information security. At admission, students may be recommended to follow a "managerial" or "technical" track, as described below. Applications are recommended to possess a master's degree in Information Assurance (or closely associated degree) from a current Center of Academic Excellence or a master's in Computer Science/Information Technology/Information Systems, with some coursework in information security fundamentals. Additionally students should have professional experience in information security and have a strong research potential in the areas of information security. Alternatively, CEC master's students in information security may apply for early admission into the Ph.D. program.

Requirements to Apply Early to the Ph.D. Program

This option provides the opportunity for master's students in information security to earn the Ph.D. in information assurance in a shorter time. In addition to the requirements specified in the section Early Admission into the Ph.D. Program, the student must complete all six ISEC-prefixed core courses and their prerequisites (CISC 640 and 650, and MSIT 630).

Curriculum for the Ph.D. in Information Assurance

The program requires at least 64 credit hours, of which 32 are for courses and at least 32 are for research and dissertation. Core courses are divided into a "managerial track" and a "technical track". Students may be recommended to follow one track but may fulfill their core course requirement using any combination of the core courses. Furthermore, students may use any additional core courses to count toward electives. Courses, research, and dissertation registrations are listed below:

Core Courses (four credits each) (Select at least three.)
Managerial Track
ISEC 755 Information Security Management
ISEC 765 Managing Risk in Secure Systems
ISEC 775 Privacy

Technical Track
ISEC 730 Network Security and Cryptography
ISEC 740 Secure Systems Analysis and Design
ISEC 750 Information Protection

Elective Courses (four credits each) (Select two to five to total eight courses.)
RESD 705 Quantitative Research Methods
Either
RESD 710 Qualitative Research Methods
or
RESD 720 Multivariate Research Methodology
DISS 720 Human-Computer Interaction
CISD 730 Operating Systems
DISS 735 Knowledge Management
Either
DISS 750 Database Systems
or
CISD 750 Database Management Systems
CISD 760 Artificial Intelligence
CISD 770 Software Engineering

Research Registrations Students are required to complete at least two sections (four credits each) of ISEC 885, Doctoral Research, before entering candidacy. Students must register for the course with a particular faculty member as directed in the course description. Students are further advised to wait for the second year of study before registering for Doctoral Research. Students will repeat Doctoral Research until securing a dissertation idea approved by the instructor and two faculty readers.

Dissertation Registrations Students must make three consecutive registrations (eight credits each) for ISEC 901, Doctoral Dissertation, to total the 24 credits of dissertation required. Students whose dissertations are not completed within three registrations (one year) continue to register for ISEC 920 Continuing Dissertation (four credits) each term until the dissertation is complete.

Ph.D. in Information Systems

This program offers a course of study leading to the degree of Doctor of Philosophy (Ph.D.) in Information Systems or the Ph.D. in Information Systems with Concentration in Information Security. Its cluster format combines traditional and online instruction to provide information technology professionals the opportunity to pursue graduate study while continuing to work in their current positions. The program is especially well suited to professionals working in areas such as information system planning, information security, systems analysis and design, project management, information system administration, information science, or software engineering. It provides information technology professionals with the knowledge and ability to develop creative solutions to substantive real-world problems in information systems. Each student must complete eight core courses, at least two research courses, and a dissertation.

The Concentration in Information Security is recognized by the National Security Agency (NSA). Students pursuing the concentration must complete the research seminar courses indicated below, as well as a dissertation in the area of information security.

A graduate with a Ph.D. in Information Systems will have the ability to: (1) acquire advanced knowledge and deeper understanding of the field of information systems; (2) communicate professionally and ethically about information systems research issues; (3) identify, analyze, and synthesize scholarly literature related to information systems; and (4) generate new knowledge through research/scholarship and disseminate that knowledge to others by demonstrating the necessary technical and intellectual skills to produce a written document that makes an original contribution to the field of information systems.

Program-Specific Admission Requirements

(For general requirements, see the section Admission.)

This program is designed for the student with a master's degree in information systems, information science, computer science, information technology, or a related area. In addition to holding a relevant master's degree, the applicant should satisfy graduate prerequisites or have equivalent experience in information systems, programming languages, database systems, systems analysis and design, telecommunications and computer networks, and statistics. Students may be admitted without course work in statistics, but will be required to complete RESD 600, Introduction to Research Methodology and Statistics, and obtain a grade of B+ or above. Alternatively, CEC master's students in management information systems or information security may apply for early admission into the Ph.D. program.

Requirements to Apply Early to the Ph.D. Program

This option provides the opportunity for master's students in information security or management information systems to earn the Ph.D. in information systems in a shorter time. In addition to the requirements specified in the section Early Admission into the Ph.D. Program, master's students in information security must complete all six ISEC-prefixed core courses in the program and their prerequisites (CISC 640 and 650, and MSIT 630), whereas master's students in management information

systems must complete the program core and all courses from the chosen concentration. Students must also have completed RESD 600, Introduction to Research Methodology and Statistics, or its equivalent elsewhere.

Curriculum for the Ph.D. in Information Systems

The program requires at least 64 credit hours, of which 32 are for courses and at least 32 are for research and dissertation. Courses, research, and dissertation registrations are as follows.

General IS (8 credits. Choose 2 courses)
DISS 720 Human-Computer Interaction
DISS 735 Knowledge Management
DISS 750 Database Systems

Research Methods (8 credits. Choose 2 courses)
RESD 705 Quantitative Research Methods (required)
RESD 710 Qualitative Research Methods
RESD 720 Multivariate Research Methodology

IS Research Seminar – Core (8 credits)
DISS 725 Information Systems Development
DISS 726 Foundations of Information Systems – Social Perspectives

IS Research Seminar – Electives (8 credits. Choose 2 courses)
DISS 710 Analytics and Business Intelligence
DISS/ISEC 755 Information Security Management
DISS/ISEC 765* Managing Risk in Secure Systems
DISS/ISEC 775* Information Privacy
***Required for students pursuing the Concentration in Information Security*

Research Registrations Students are required to complete at least two sections (four credits each) of DISS 885, Doctoral Research, before entering candidacy. Students must register for the course with a particular faculty member as directed in the course description. Students are further advised to wait for the second year of study before registering for Doctoral Research. Students will repeat Doctoral Research until securing a dissertation idea approved by the instructor and two faculty readers.

Dissertation Registrations Students must make three consecutive registrations (eight credits each) for DISS 901, Doctoral Dissertation, to total the 24 credits of dissertation required. Students whose dissertations are not completed within three registrations (one year) continue to register for DISS 920 Continuing Dissertation (four credits) each term until the dissertation is complete. Students who are pursuing the Concentration in Information Security must complete a dissertation in an area of information security / assurance.

Course Descriptions (Graduate Courses)

CISC 500 Java Programming Language (3 credits)
An in-depth study of the Java programming language. Principles of the object-oriented paradigm. Object-oriented programming theory and practice.

CISC 501 Computer Organization and Architecture (3 credits)
A comprehensive examination of the fundamental concepts, organization, and architectural structures of contemporary computers. Topics include: logic design, fundamental structure of computer hardware systems (CPU/ALU, memory, cache, registers, I/O), instruction sets, assembly language programming, computer arithmetic, pipelining, and memory hierarchy.

CISC 502 Mathematics in Computing (3 credits)
Graph theory, lattices and boolean algebras, state models and abstract algebraic structures, logical systems, production systems, computability theory, recursive function theory.

CISC 503 Data Structures and Algorithms (3 credits)
Sorting and searching, algorithms for tree structures, advanced data structures, graph algorithms, complexity, dynamic programming, optimization problems. Prerequisite: CISC 500 or equivalent.

CISC 610 Programming Languages (3 credits)
The study of the organization and types of programming languages including analysis of imperative, object-oriented, functional, and declarative language paradigms. Other topics include formal languages and language hierarchies, syntactic and semantic specification, context-free languages, abstraction, modularity, program structure and fundamental programming language concepts.

CISC 615 Design and Analysis of Algorithms (3 credits)
Principles and techniques used in the design and analysis of computer algorithms. Topics include sorting, algorithms for tree structures, dynamic programming, greedy methods, advanced data structures, divide and conquer, graph algorithms, arithmetic operations, algorithms for parallel computers, matrix operations, string/pattern matching, network problems, approximation algorithms, and NP-completeness.

CISC 630 Compilers (3 credits)
Application of language theory to the design of compilers and interpreters for high-level programming languages. Lexical, syntactic, and semantic analysis, and code generation. Other topics include storage allocation, symbol table management, optimization, and the use of modern compiler generation tools. Prerequisites: CISC 610 and CISC 631.

CISC 631 Theory of Computation (3 credits)
Automata and language theory: regular and context free languages; finite state automata and pushdown automata; regular expressions; pumping lemmas. Computability theory: Turing machine and its variants; decidability and reductions; recursive, recursively enumerable (r.e.), and non-r.e. languages. Complexity theory: time complexity and NP-completeness; a survey of NP-complete problems; space complexity and PSPACE-completeness.

CISC 640 Operating Systems (3 credits)
Concepts of computer operating systems are presented with an emphasis on structured design. Topics include operating systems structure, multiprocessing, synchronization and communication, task management, virtual memory management, file systems, protection and security, operating system extension techniques, fault tolerance, and systems programming. Recent developments in operating systems theory and implementation are covered.

CISC 647 Computer Architecture (3 credits)
Characteristics and organization of modern processors are presented with an emphasis on the concepts and design of architecture for computer systems and subsystems (personal computers, servers, and embedded devices). Topics include processor fundamentals, instruction set principles, instruction-level parallelism, cache hierarchies, memory organization, virtual memory, multiprocessors and parallel architectures, thread-level parallelism, I/O and storage systems, performance evaluation, fault-tolerance, and clusters.

CISC 650 Computer Networks (3 credits)
The concepts of computer networks and network services, communication protocols, network and protocol architectures, packet switching techniques, the Internet architecture, topology, internetworking, TCP/IP, network design and analysis methods, switching, and routing. Topics include wired and wireless

Ethernet, software and conceptual models, error detection, error correction, transfer and routing protocols, congestion and flow control, quality-of-service, network programming, security, current and future applications.

CISC 660 Database Management Systems (3 credits)
Concepts of three levels of database architectures and their relationships, DBMS internals and their functions with associated API interfaces, various types of data models and their implementations in both internal and external perspectives, principles and techniques for database design and implementation, organizations of data and file structures and access methods, theory of query processing and optimization, mechanisms of concurrency control and transaction processing, and other new trends of database technologies.

CISC 662 Data Mining and Knowledge Discovery in Databases (3 credits)
Concepts, principles, and techniques of data mining and knowledge discovery. Topics include, but not limited to, classification and inductive learning, association rules mining, neural network and Bayes methods, cluster analysis, rough sets and fuzzy sets approaches for data mining, statistical methods for data mining, model and metrics for evaluating data mining results, etc. Prerequisite: CISC 660.

CISC 665 Distributed Systems (3 credits)
Concepts and design of distributed systems and applications with an emphasis on protocols and distributed state. Topics include distributed systems architecture (system models, communication, and peer-to-peer systems); middleware (distributed objects, security, directory services, and web services); distributed systems infrastructure (distributed file systems, and distributed shared memory); distributed state coordination (time and global states, coordination, transactions, concurrency control, and replication); mobile and ubiquitous computing and future research directions. This course extends the foundation of operating systems and computer networking. Prerequisites: CISC 640 and CISC 650.

CISC 670 Artificial Intelligence (3 credits)
Theory and practice of artificial intelligence and knowledge-based expert systems. Topics include knowledge representation and inference, heuristic and adversary search, genetic algorithms, machine learning, neural computing, reasoning under uncertainty, symbolic programming using Lisp, logic programming using Prolog, and expert systems. Development and implementation of algorithms for intelligent systems is emphasized. Examples from current application areas such as robotics, planning, machine vision, natural language processing, and intelligent agents are used to reinforce the concepts.

CISC 680 Software Engineering (3 credits)
The development of software-intensive systems; software quality factors; software engineering principles; system life-cycle models and paradigms; requirements definition and analysis; behavioral specification; software design; implementation; software testing techniques; verification and validation; system evolution; software project management.

CISC 681 Computer Graphics (3 credits)
Principles of computer graphics, including fundamental raster operations including scan conversion, fill methods, and anti-aliasing. Coordinate systems, transformations, scene graphs and other 3D modeling methods. Rendering, hidden surface removal and ray tracing. Animation; graphical user interfaces. Modern computer graphics languages.

CISC 682 Software Requirements Engineering (3 credits)
Focuses on the requirements phase situated within the larger development process. Specific topics include requirement gathering, specification languages, methodologies, and tools. Prerequisite: CISC 680.

CISC 683 Object-Oriented Design (3 credits)
Principles and concepts of the object-oriented paradigm. Notation and techniques for the analysis, design, and implementation of object-oriented systems. Mechanisms for reuse, including composition, inheritance, design patterns, and application frameworks. Object-oriented programming.

CISC 684 Software Testing and Verification (3 credits)
Focuses on the testing phases situated within the larger development process. Students will learn and practice various ways of testing for correctness as well as secondary factors such as performance, robustness, reliability, security, and others. Students from other programs may be able to take this course as an elective; contact your academic advisor to register. Note that the course expects students to have academic or professional experience in software development.

CISC 685 Interaction Design (3 credits)
Focuses on the dynamics of human-computer interaction (HCI). Provides a broad and comprehensive overview of HCI as a sub-area of computer science and implements user-centered design approaches to computer systems including Internet and web-based environments. Areas to be addressed include the user interface and software design strategies and methodologies, user experience levels, interaction styles, and usability engineering. Students will design, evaluate, implement, and test user interfaces using appropriate computer science concepts and methodologies using current programming language environments.

CISC 688 Continuing Thesis in Computer Science (1.5 credits)
Students who have not completed the thesis by the end of the second thesis registration must register for continuing thesis. This allows the student to receive faculty and administrative advice and support related to the thesis. Prerequisite: Completion of second thesis registration.

CISC 690 Special Topics in Computer Science (3 credits)
This seminar focuses on the professor's current research interests. Prerequisite: Consent of the course professor and program director based on student's qualifications.

CISC 699 Master's Thesis in Computer Science (3 credits)
The student develops a framework within which research will be conducted and offers evidence of qualifications to pursue the research. Concepts and theories underlying the student's thesis research are articulated; the problem is clearly stated; specific, measurable goals are specified; a literature review is presented; the methods of conducting research are delineated; and strategies to achieve the goal are supplied. Registration for CISC 699 must be repeated for three more credits, for a total of six thesis credits. Prerequisite: Completion of eight courses at the 600-level.

CISD 700 Theory and Principles of Programming (4 credits)
Syntax of programming languages by parsing to abstract syntax. Semantics of common language constructs using an interpreter: arithmetic, symbolic, and conditional expressions; blocks; lexically-scoped recursive first-class procedures; control structures; and parameter passing variations. Static type checking and type inference; imperative, functional, and object-oriented language paradigms. Recent research and current trends.

CISD 730 Operating Systems (4 credits)
Recent advances in the theory and practice of state-of-the-art methods in the structure and development of operating systems with an emphasis on parallel and distributed systems. Topics include research in operating system architectures, clusters, parallel and distributed operating systems, real-time issues, performance, and software engineering issues associated with systems development. An emphasis will be placed on current systems development, future directions, and research topics.

CISD 740 Data Communications and Computer Networking (4 credits)
Recent advances and trends in data communication and computer network research are explored with a focus on design and analysis. Included in the course topics are network structure, protocols, layering, wireless communication, ad-hoc and mobile networking, resource discovery and management, and network management. The course materials will provide a foundation for the study of recent advances and new applications in the expanding field of ad-hoc, mobile, and ubiquitous computing. Current topics are presented, as well as future research trends.

CISD 750 Database Management Systems (4 credits)
Theory and principles of databases and their management. Selected topics in design and implementation of traditional and nontraditional database management systems to retrieve and store various types of data. Current issues, trends, future directions, and research topics in the areas will be explored.

CISD 760 Artificial Intelligence (4 credits)
Theory and applications of artificial intelligence. Topics include knowledge representation, search, machine learning, and reasoning under uncertainty. Recent research and current trends are explored.

CISD 770 Software Engineering (4 credits)
Covers advanced topics in areas of current research interest in the development of software-intensive systems. Topics may include metrics, requirements definition, development life cycles, software engineering processes, reuse, formal methods, verification and validation, and project management.

CISD 792 Computer Graphics (4 credits)
Principles of computer graphics including raster operations and 3D graphics: transformations, scene graphs and other modeling methods, hidden surface removal and rendering, programming and graphics systems, visualization, and computer animation. Recent research and current trends will be explored.

CISD 794 Knowledge Discovery in Databases (4 credits)
This course will study a number of emerging technical approaches to knowledge discovery in databases such as algorithms for mining various types of data, measurements for set of mined rules, classification and predication, data clustering and summarization, finding dependency networks, analyzing changes, detecting anomalies, and their applications. Current issues, trends, future directions, and research topics in the areas will be explored. Prerequisite: CISD 750.

CISD 799 Special Topics in Computer Science (4 credits)
Covers advanced topics in areas of current research interest in computer science. May include topics in advanced computer architecture, artificial intelligence, distributed database management systems, advanced computer graphics, object-oriented technology, and parallel computation. Topics will vary depending on student and faculty interest. Depending on interest, several special topics courses may be offered concurrently.

CISD 885 Doctoral Research (4 credits)
The student pursues research under the direction of a faculty member. To register, students contact their advisor with the name of the faculty member under whose direction they would like to work and a brief explanation of the research area to be explored. Recommended prerequisite: completion of a 700-level course with the requested professor with a grade of B+ or higher.

CISD 901 Doctoral Dissertation (8 credits)
The student develops an accepted proposal for the study, conducts the research as proposed, submits an acceptable report, and successfully defends the dissertation. Repeated twice.

CISD 920 Continuing Dissertation (4 credits)
Students who have not completed the dissertation after three registrations of Doctoral Dissertation must register for Continuing Dissertation each term in order to receive faculty and administrative advice and support related to the dissertation. Prerequisite: 24 credits of Doctoral Dissertation

DISS 710 Analytics and Business Intelligence (4 credits)
Principles and techniques relating to applications of analytics for organizational problem solving. The focus is on current research in analytics and business intelligence. Topics include optimization models for prescriptive analytics, machine learning techniques for predictive analytics, and analysis and design of business intelligence applications.

DISS 720 Human-Computer Interaction (4 credits)
Issues relating to effective HCI are presented. Design elements, procedures, tools, and environments contributing to the management of successful user interfaces are examined. Other topics include current and projected developments in HCI research related to information systems.

DISS 725 Information Systems Development (4 credits)
Acquire advanced knowledge and deeper understanding of system development process including theories and studies related to system life-cycle models, system development strategies, and implementation success. Review of relevant research in the area of techniques, methods, and tools for the analysis and specification of information systems. Review of studies dealing with design principles, requirements gathering, reusability, and quality assurance. Moreover, review of studies and theories relevant to verification and validation process, integration and acceptance testing, reliability measurements, system testing techniques, end-user computing, implementation effectiveness, and system value. Additionally, review of classical theories in information systems and system analysis and design.

DISS 726 Foundations of IS Research – Social Perspectives (4 credits)
This is a doctoral seminar on the foundations of information systems (IS) research. The course is intended to generate an understanding of some major streams of research in information systems. It will emphasize the value of using different perspectives and methodologies in IS research. The course involves reading and discussion of the research literature on the development, use, and impact of information systems at individual, group, organizational, and societal levels. Prerequisite: RESD 705.

DISS 735 Knowledge Management (4 credits)
Acquire advanced knowledge and deeper understanding of knowledge management including theories and studies related to knowledge management and knowledge management systems. Review of relevant research in the area of locating, evaluating, disseminating, and using information as well as knowledge. Review of studies and theories relevant to knowledge acquisition, information sharing, information ownership, knowledge process, knowledge integration, knowledge gathering, knowledge repositories, and knowledge reuse. Additionally, review of current research in knowledge management and knowledge management systems.

DISS 745 Electronic Commerce (4 credits)
This course examines the theories, frameworks and methodologies used to study the strategic impact of electronic commerce on systems, organizations, and markets. The goal of the course is to provide doctoral students with the necessary background knowledge to appreciate eCommerce research in the IS field and to develop academic research proposals.

DISS 750 Database Systems (4 credits)
Theory and principles of databases and their management. Selected topics in design, implementation, and applications of traditional and nontraditional database systems for various types of data management. Current issues, trends, future directions, applications, and research topics in the areas will be explored.

DISS 770 Information Policy (4 credits)
Information technology's dramatic global impact on society, government, and the economy has given rise to complex legal, regulatory, and policy issues. This course explores issues ranging from the consequences of information commodification to the impact of privacy concerns, eCommerce, information ownership (patents/copyrights/trademarks), social equity, crime, free speech, telecommunications, national security, international trade, etc. All have immediate relevance to the IT workplace. While U.S. policy issues serve as the framework for the course, the U.S. experience is compared and contrasted to policy developments worldwide.

ISEC 775 Information Privacy (4 credits)
This course examines the privacy issues regarding information systems. The focus is on understanding distinctive research orientations regarding information privacy. Discussions will emphasize critical evaluation of theoretical foundations of privacy in our modern technologically based society. The goal of the course is to provide an intellectual foundation for students to develop an appropriate research program in this area.

DISS 885 Doctoral Research (4 credits)
The student pursues research under the direction of a faculty member. To register, students contact their advisor with the name of the faculty member under whose direction they would like to work and a brief explanation of the research area to be explored. Recommended prerequisite: completion of a 700-level course with the requested professor with a grade of B+ or higher.

DISS 901 Doctoral Dissertation (8 credits)
The student develops an accepted proposal for the study, conducts the research as proposed, submits an acceptable report, and successfully defends the dissertation. Repeated twice.

DISS 920 Continuing Dissertation (4 credits)
Students who have not completed the dissertation after three registrations of Doctoral Dissertation must register for Continuing Dissertation each term in order to receive faculty and administrative advice and support related to the dissertation. Prerequisite: 24 credits of Doctoral Dissertation.

ISEC 600 Secure Computer Systems (3 credits)
This course will focus on design principles of trusted computing bases (TCB). Issues regarding authentication, access control and authorization, discretionary and mandatory security policies, secure kernel design, secure operating systems, and secure databases will be covered from a systems architecture perspective. Emphasis will be on the design of security measures for critical information infrastructures. Prerequisites: MSIT 630 or CISC 660, CISC 640, and CISC 650.

ISEC 615 Fundamentals of Security Technologies (3 credits)
An overview of the technical aspects of information security. Issues discussed include authentication, confidentiality, access control, trust and non-repudiation. Investigation of fundamental assurance technologies that can be applied to interface specifications, architectures, and implementations of information security mechanisms. The selection of appropriate security applications, security lifecycles, and interoperability issues will also be covered. Students who do not have prior exposure to computer networking are recommended to take MMIS 653, Telecommunications and Computer Networking, prior to taking this course.

ISEC 620 Applied Cryptography (3 credits)
Analysis of cryptographic algorithms, cryptanalysis, symmetric cryptography, public key cryptography, DES, AES, RSA, hash and MAC functions, digital signatures, pseudo-random generators, cryptographic protocols, SSL/TLS, SET. Prerequisites: CISC 502 (or equivalent), CISC 640, and CISC 650.

ISEC 635 Information Security Operations Management (3 credits)
Provides an understanding to implement effectively the information security vision and strategy set forth by the executive management. The emphasis will be on the management of an information security program. Focus is on the implementation of information security policy, information security planning, development of information security processes, and establishment of information security measures. Concepts and techniques from the management and organizational behavior disciplines will be integrated in order to identify and propose solutions to the problems of information security administration.

ISEC 640 Database Security (3 credits)
This course will focus on issues related to the design and implementation of secure data stores. Emphasis will be placed on multilevel security in database systems, covert channels, and security measures for relational and object-oriented database systems. Prerequisites: MSIT 630 or CISC 660, and CISC 640.

ISEC 655 Information Security Governance (3 credits)
Challenges and opportunities of effectively governing an organization's information security requirements and resources. Information security governance lays out the vision for the information security program. Discussions include what constitutes good information security governance, and development of an effective information security strategy and policy. Also focuses on how to improve information security accountability, regulatory compliance, and maturity.

ISEC 660 Advanced Network Security (3 credits)
Fundamental concepts, principles, and practical networking and internetworking issues relevant to the design, analysis, and implementation of enterprise-level trusted networked information systems. Topics include networking and security architectures, techniques, and protocols at the various layers of the Internet model. Security problems in distributed application environments will be analyzed and solutions discussed and implemented. Prerequisites: CISC 640, 650.

ISEC 670 Fundamentals of Information Security (3 credits)
A thorough overview of the principles of information security, security architectures and models, physical security control, operations security, access control, systems and programs security, cryptography, network and internet security, and threats and vulnerabilities. Students will also learn how to plan and manage security, security policies, business continuity plans, disaster recovery plans, and social and legal issues of information security.

ISEC 675 Information Systems Auditing (3 credits)
Fundamental concepts related to an information systems audit. Principles and practices related to secure operation of existing information technology. Information security accountability, development of internal control objectives and framework, and identification of appropriate audit procedures for a secure information system. Prerequisites: ISEC 615, 635.

ISEC 690 Information Security Project (3 credits)
This project course integrates all of the knowledge accumulated through the previous courses and serves as a capstone for the Concentration in Information Security. The class focuses on techniques for protecting critical information infrastructures through case studies, application development, and systems assessment. Prerequisites: ISEC 600, 620, 640, and 660. Upon request, the course may be taken concurrently with one of the prerequisite courses. Such a request will only be approved in the last term of

a student's matriculation, and students taking a prerequisite concurrently are subject to the same expectations as those who have completed all prerequisites.

ISEC 695 Information Security Management Project (3 credits)
This project course integrates all of the knowledge accumulated through the previous courses and serves as a capstone for the Concentration in Information Security Management. The course focuses on integrating best practices demonstrated through case studies and systems assessment in order to help students develop a final information security management capstone project. Students may enroll in this class only after completing all of the information security management concentration courses. Prerequisites: ISEC 615, 635, 655, and 675. Upon request, the course may be taken concurrently with one of the prerequisite courses. Such a request will only be approved in the last term of a student's matriculation, and students taking a prerequisite concurrently are subject to the same expectations as those who have completed all prerequisites.

ISEC 730 Network Security and Cryptography (4 credits)
Study of the technical challenges of securing computer networks, the tools and techniques that have been developed to address these challenges, and the current research in protecting critical information networks. Topics in the course will include network protocols designed to enhance security, wireless security approaches, intrusion detection, cryptography, and authentication and access control techniques. A significant focus of the course will be on current and emerging network security research areas.

ISEC 740 Secure Systems Analysis and Design (4 credits)
Study of the tools and methodologies utilized in analyzing and assessing the security of critical information systems. Topics include the design of secure architectures, vulnerability assessments, and the analysis of potential security threats. An emphasis will be placed on current issues, future directions, and research opportunities for students in this field.

ISEC 750 Information Protection (4 credits)
This course will discuss the current and emerging technologies that enable the protection of information resources on host-based, networked, and mobile systems. The course will focus on methods to identify malicious activity and software and on approaches to harden systems that may be subject to attack.

ISEC 755 Information Security Management (4 credits)
This course examines the philosophical and theoretical foundations of information systems security. The focus is on understanding distinctive research orientations regarding effectively securing information systems in organizations. The goal of the course is to provide an intellectual foundation for students to develop an appropriate research program in this area.

ISEC 765 Managing Risk in Secure Systems (4 credits)
Study of the theory and practice of risk management in secure systems and networks. The course will focus on the current tools and best practices available in mitigating system vulnerabilities and the accepted methodologies for managing residual risks. Topics include operational security, risk reduction techniques, auditing of information systems, and effective long-term risk monitoring approaches. An emphasis will be placed on current issues and future directions in managing risks, and research opportunities for students in this field.

ISEC 775 Information Privacy (4 credits)
This course examines the privacy issues regarding information systems. The focus is on understanding distinctive research orientations regarding information privacy. Discussions will emphasize critical evaluation of theoretical foundations of privacy in our modern technologically based society. The goal of the course is to provide an intellectual foundation for students to develop an appropriate research program in this area.

ISEC 885 Doctoral Research (4 credits)
The student pursues research under the direction of a faculty member. To register, students contact their advisor with the name of the faculty member under whose direction they would like to work and a brief explanation of the research area to be explored. Recommended prerequisite: completion of a 700-level course with the requested professor with a grade of B+ or higher.

ISEC 901 Doctoral Dissertation (8 credits)
The student develops an accepted proposal for the study, conducts the research as proposed, submits an acceptable report, and successfully defends the dissertation. Repeated twice.

ISEC 920 Continuing Dissertation (4 credits)
Students who have not completed the dissertation after three registrations of Doctoral Dissertation must register for Continuing Dissertation each term in order to receive faculty and administrative advice and support related to the dissertation. Prerequisite: 24 credits of Doctoral Dissertation.

MITE 612 Authoring Systems (3 credits)
The goal of this course is to provide the student with both the practical application and theoretical background necessary to author computer-based products to promote learning. While using a current instructional authoring system such as Articulate or CourseLab to develop a computer-based educational product, the student will also examine applicable standards such as SCORM and basics of multimedia instructional design.

MITE 628 Learning Design (3 credits)
The goal of this course is to help students develop design competencies that are appropriate for the development of e-learning products. Students will experience both theory and best practices from the areas of education and training and will apply design concepts, principles, and procedures to create an e-learning artifact.

MITE 642 Online Communities (3 credits)
The course focuses on online communities, primarily theoretical and conceptual foundations of online communities for learning. Topics may include defining and assessing needs for building community and evaluating sense of community. Also examined are the design, creation, and evaluation of knowledge domains and online environments to support engagement and learning.

MITE 655 Foundations of Learning Technology (3 credits)
In this course students look to the past, study the present, and explore the future to inform their individual perspectives and views about how technology can be used to improve teaching, learning, and training. Through a variety of learning activities, students will develop a basic awareness of learning technology concepts and the trends and issues that are shaping the future.

MITE 661 E-Learning (3 credits)
The course explores research trends in the area of online learning. Students will explore the requirements needed for successful online learning and teaching. Topics investigated may include the process of teaching and learning in an online learning environment (OLE), evaluating effective courseware and online communications technologies, integration of technology into OLEs, working with online classroom dynamics, addressing the needs of the online student, making the transition to online teaching, promoting the development of an online learning community, comparing Learning Management Systems, and investigating emerging trends in e-learning and e-training in industry settings.

MITE 670 Learning Theories (3 credits)
Students will explore the intersection of learning theory and technology by investigating how learning technologies can be used to facilitate effective online learning environments with learners of all ages, in

all settings. Three major frameworks including behaviorism, cognitivism, and constructivism will be examined. Students will also consider new theoretical perspectives that frame learning and teaching in the 21st century.

MMIS 501 Introduction to Java Programming (3 credits)
An introduction to the Java programming language. The course includes an introduction to the concepts of object-oriented programming and shows how Java supports this programming paradigm. Students learn about the Java environment and write both applets (programs that execute in a web browser) and applications (stand-alone programs). In addition to learning about basic language statements, students learn how Java provides support for such diverse applications as web pages, multimedia, education, etc.

MMIS 520 Management Information Systems (3 credits)
The application of information system concepts to the collection, retention, and dissemination of information for management planning and decision making. Issues such as personnel selection, budgeting, policy development, and organizational interfacing are discussed. Conceptual foundations and planning and development of management information systems. The role of MIS in an organization and the fit between the system and the organization.

MMIS 621 Information Systems Project Management (3 credits)
Practical examination of how projects can be managed from start to finish. Life-cycle models/paradigms. Life-cycle phases. Project planning and risk analysis. Project control including work breakdown structures, project scheduling, activities and milestones. Software cost estimation techniques and models. Software quality assurance and metrics for software productivity and quality. Inspections, walkthroughs, and reviews. Documentation and configuration management. Automated project management tools. Software maintenance. Procurement of software services and systems and development of IS project specifications. Project management skills including leadership, team building, planning, time management, resource allocation, conflict management, and using IS project management in strategic planning. Ethics in project management. Case studies are used throughout the course to support concepts, principles, and problem solving.

MMIS 623 Information Privacy and Ethics (3 credits)
Building on a foundation in classical ethics, we examine the impact of the computer and the Internet on our society. Topics include ethical decision making; professional codes; whistle-blowing; computer crime; copyrights, patents and intellectual property; privacy; and risk management. Students analyze case studies and write a research paper.

MMIS 627 Enterprise Technologies and Infrastructures (3 credits)
Focuses on enterprise-level information systems, technologies, and infrastructures that are emerging as the first generation 21st century application integration design strategies and tools. Included are managing web-based client/server and distributed environments, evaluation of vendor strategies, legacy system migration issues, performance, interoperability, scalability, and security concerns, web services foundations, types of middleware, vendor architectures, distributed applications, the context for integration, service-oriented application integration, multi-enterprise portals, mobile devices, business process integration, Java-based middleware standards, web services APIs, and emerging standards. Cases of enterprise systems and architectures are analyzed.

MMIS 628 Enterprise Systems and Business Processes (3 credits)
Students will learn about business processes and how those processes are supported by and enhance through the use of enterprise systems. The course is designed to give students experience supporting business processes using enterprise technologies and ERP concepts. Specifically, students will learn the role that enterprise systems play in the procurement, fulfillment, production, inventory and warehouse

management, and material planning processes of an organization. Other topics include process integration and accounting fundamentals.

MMIS 630 Database Management and Applications (3 credits)
The application of database concepts to management information systems. Design objectives, methods, costs, and benefits associated with the use of a database management system. Tools and techniques for the management of large amounts of data. Database design, performance, and administration. File organization and access methods. The architectures of database systems, data models for database systems (network, hierarchical, relational, and object-oriented model), client-server database applications, distributed databases, and object-oriented databases.

MMIS 636 Computer-Supported Cooperative Work (3 credits)
The scope of the CSCW field will be examined, including theoretical, practical, technical, and social issues and future directions of the field. Focus will be on the way people work in groups and core dimensions of online cooperative work. Students will examine theoretical CSCW models, review and critique innovations in collaborative technologies, and address social and organizational challenges of CSCW environments. Various group interactions and concerns in online collaborative activities are addressed such as awareness, communication, decision-making, shared writing and editing, coordination, meetings and meeting spaces, information management, and other contextual factors in the workplace.

MMIS 638 Computer-Mediated Communication (3 credits)
The course introduces students to computer-mediated communication (CMC) research foundations, including history, theory, concepts and current issues. Students explore CMC practices, various CMC tools, and their effects in various work contexts. Topics may include CMC modes, the changing nature of communication through CMC advancements, public and private digital participation, digital identity, control attention and critical consumption of information using CMC, and cultivating network-savvy communication skills and conveying meaning accurately through CMC.

MMIS 642 Data Warehousing (3 credits)
This course includes the various factors involved in developing data warehouses and data marts: planning, design, implementation, and evaluation; review of vendor data warehouse products; cases involving contemporary implementations in business, government, and industry; techniques for maximizing effectiveness through OLAP and data mining. Prerequisite: MMIS 630.

MMIS 643 Data Mining (3 credits)
This course emphasizes the fundamental concepts and techniques of data mining. Concepts will be illustrated with case studies of real data mining examples. The focus is to find knowledge from huge amounts of data being handled electronically. Students will gain hands on experience using data mining tools on real data. Prerequisite: MMIS 671 or QNT 5040, and MMIS 630.

MMIS 644 Social Media (3 credits)
Students will explore key issues in social media technologies. Topics may include the value of social media for distributed education, current and future trends in social software, delivering content using specific applications (blogs, wikis, podcasts, webcasts, etc.), the impact of social media tools to transform teaching and learning, and issues of course design to support learner engagement and online social media use in distributed and mobile environments.

MMIS 646 Information Visualization (3 credits)
Information visualization focuses on visualization techniques to help people understand, analyze, and make decisions based on data. This course will examine principles and techniques for developing effective visualizations, and provide experience using some common visualization systems and techniques. Programming experience is not required.

MMIS 650 Fundamentals of Cloud Computing (3 credits)
Students will learn the basic concepts and terminologies of cloud computing via lectures and hands-on laboratory examples. Topics to be discussed include the definition of cloud computing, evolution of cloud computing, virtualization, cloud computing delivery models (SaaS, PaaS, IaaS), and the various cloud computing deployment methods (public, private, hybrid, and community).

MMIS 653 Telecommunications and Computer Networking (3 credits)
This course provides a framework for understanding computer network functionality, characteristics, and configurations. Topics include network topologies, protocols, and architectures and emerging trends in network technologies and services. The role of optical technologies in supporting national and international implementations is explored. Strategies for network planning, implementation, management, and security are introduced. Recent advances in standardization, internetworking, and deployment of LANs (local area networks), MANs (metropolitan area networks), and WANs (wide area networks) are introduced.

MMIS 654 Electronic Commerce on the Internet (3 credits)
This course examines the foundation, operation, and implications of the Internet economy. Topics include Internet technologies, online market mechanisms, interactive customers, knowledge-based products, smart physical products and services, pricing in the Internet economy, online auctions and e-marketplaces, digital governance, policies for the Internet economy and an outlook for the new economy.

MMIS 656 Web Design Technologies (3 credits)
A hands-on introduction to a variety of technologies involved in the design, development, and implementation of Websites. The course provides an overview with hands-on examples for Web design and development, including database-backed dynamic content generation and emerging technologies in Internet content delivery. Topics include fundamentals of Web design and development technologies, including technologies such as XHTML, cascading style sheets, JavaScript, XML, Flash, PHP, Ajax, Java Web Software, ASP.NET, and Ruby. Students are expected to have a fundamental knowledge of at least one programming language. Prerequisite: MMIS 654.

MMIS 660 Systems Analysis and Design (3 credits)
Analysis of requirements for information systems. Elicitation/fact-finding, problem analysis, decomposition, and the requirements document. Concepts, methods, techniques, and tools for systems analysis, modeling and simulation, and prototyping. Structured and object-oriented analysis. Role of the systems analyst in the organization. Gaining user commitment and fulfilling user needs. Concepts, tools, and techniques for systems design. Design principles, quality factors, decomposition of complex systems, and modularization techniques. Design methods such as object-oriented and function-oriented design. Comparison of analysis and design techniques.

MMIS 665 Information Systems Strategy (3 credits)
Students will learn the basic concepts and issues related to the formulation and execution of IS strategy in organizations. Topics to be discussed include the IS strategy triangle, business/IT strategic alignment, strategic architecture and infrastructure issues, IS governance, and the ethical use of information.

MMIS 671 Fundamentals of Analytics and Business Intelligence (3 credits)
This course examines concepts and methods central to analytics and business intelligence systems. The focus is on the application of management science and artificial intelligence techniques for prescriptive and predictive analytics. Case studies of existing systems are used to reinforce concepts discussed in class. A major component of the course is a project entailing the design, implementation, and evaluation of prototype systems for business intelligence applications.

MMIS 680 Human-Computer Interaction (3 credits)
The dynamics of human-computer interaction (HCI) are examined with a blend of theory and practice pertaining to the study of information systems. Provides a broad and comprehensive overview and offers specific background relating to user-centered approaches in the design and evaluation of information systems applications. Areas to be addressed include the user interface and software design strategies, user experience levels, interaction styles, usability engineering, web site usability, and collaborative systems technology. Students will perform formal interface evaluations and usability tests applied to current information systems technology.

MMIS 681 Multimedia Systems (3 credits)
Introduction to multimedia systems. Definitions of terms and concepts related to multimedia. Trends in the development and the use of multimedia. Tools, techniques, and guidelines facilitating the planning, design, production, and implementation of multimedia products.

MMIS 688 Continuing Thesis in Management Information Systems (1.5 credits)
Students who have not completed the thesis by the end of the second thesis registration must register for continuing thesis. This allows the student to receive faculty and administrative advice and support related to the thesis. Prerequisite: Completion of second thesis registration.

MMIS 691 Special Topics in Management Information Systems (3 credits)
This seminar focuses on the professor's current research interests. Requires consent of course professor and program director.

MMIS 692 Capstone Project in Business Intelligence (3 credits)
This capstone project requires students to employ the knowledge and skills assimilated in the prerequisite courses to design and develop a business intelligence application that leads to direct and measurable value for the students' organizations. Prerequisites: MMIS 630, 642, and 643.

MMIS 699 Master's Thesis in Management Information Systems (3 credits)
The student develops a framework within which research will be conducted and offers evidence of qualifications to pursue the research. Concepts and theories underlying the student's thesis research are articulated; the problem is clearly stated; specific, measurable goals are specified; a literature review is presented; the methods of conducting research are delineated; and strategy to achieve the goal is given. Registration for MMIS 699 must be repeated for three more credits, for a total of six thesis credits. Prerequisite: Completion of eight courses at the 600-level.

MSIT 500 Foundations of Systems (3 credits)
Concepts and foundations of the key aspects of computer systems and networks are presented. Topics include computer architecture, data storage, data manipulation, program execution, operating systems, networking, internetworking, data abstractions, and database systems.

MSIT 501 Foundations of Programming, Data Structures, and Algorithms (3 credits)
Concepts and foundations of computer science, including procedural and object-oriented programming, data structures, algorithms, and algorithm design, are introduced through programming in Python.

MSIT 630 Database Systems (3 credits)
Methodologies and principles of database analysis and design are presented. Conceptual modeling and specifications of databases, database design process and tools, functional analysis, the entity-relationship model, and advanced semantic modeling methods are discussed. Topics include theories of database systems, including the architectures of database systems, logical and physical database organizations, data models for database systems (network, hierarchical, relational, and object-oriented model), relational algebra and calculus, query languages, normal forms, null values and partial information, relational

database design utilizing dependencies, view design and integration, concurrency control, query optimization, client-server database applications, distributed databases, object-oriented databases, and the current research and development trends of database analysis, design, modeling, and applications.

MSIT 638 Database Capstone Project (3 credits)
Students will apply the concepts of data organization, data mining, and decision tasks in a project that parallels a real-world deployment. The project will provide Information Technology database design, deployment, monitoring, mining and decision support experience. Prerequisites: MMIS 671 and MMIS 643

MSIT 650 Platform and Network Technologies (3 credits)
An information technology application development and administration perspective of operating systems and networks. Operating system and network concepts of interfacing, virtual machines, process management, storage management, protection, security, network infrastructure, communication protocols, configuration, and administration are presented.

MSIT 652 System Integration and Administration (3 credits)
The conceptualization and application of operating system and networking integration, administration, and maintenance tasks are presented. Topics include installation, configuration, and maintenance of application and system software, virtual machines, file systems, file servers, web systems, and monitoring tools. Administration tasks such as system documentation, policies, procedures, and user support are discussed. Prerequisite: MSIT 650.

MSIT 654 Database Integration and Administration (3 credits)
The conceptualization and application of database integration, administration, and maintenance tasks are presented. Topics include installation, configuration, and maintenance of database software, and monitoring tools. Administration tasks such as system documentation, policies, procedures, and user support are discussed along with data deployment schemes. Prerequisites: MSIT 630 and MSIT 652

MSIT 658 System and Database Administration Capstone Project (3 credits)
Students will apply the concepts of system and database integration, administration, and maintenance tasks in a project that parallels a real-world deployment. The project will provide Information Technology system and database design, deployment, monitoring, and maintenance experience. Prerequisite: MSIT 654.

MSIT 660 Software Development (3 credits)
The development of application software in support of Information Technology deployments; software quality factors; software development principles; life-cycle models; requirements definition and analysis; behavioral specification; software design; implementation; software testing; verification and validation; maintenance; software project management; and programming language impacts on information technology application development.

MSIT 662 Mobile Application Development in iOS (3 credits)
Study of the development of real-world iOS applications using a variety of software engineering techniques. Topics include data management, persistence mechanisms, user-interface design, and application lifecycles. Students may be able to deploy their work on the Apple AppStore at the completion on the course. Prerequisite: MSIT 665.

MSIT 664 Mobile Application Development in Android (3 credits)
Study of the development of real-world Android applications. Significant focus on UI design as well as activities, services, intents, web services, local database storage, and security. Students may be able to deploy their work on the Apple AppStore at the completion on the course. Prerequisite: MSIT 665.

MSIT 665 Web Services (3 credits)
Concepts and principles of web application development are presented. The focus of this course is on distributed application design and implementation. Topics include the role of the GUI and front-end development tools, HTTP, HTML, web services, and database interaction. Discussions include the various relationships between web applications and business processes along with concerns for meeting customer requirements. Prerequisites: MSIT 650 and MSIT 660.

MSIT 668 Application Development Capstone Project (3 credits)
Students will apply the concepts of application requirements, specification, development, integration, and maintenance tasks in a project that parallels a real-world deployment. The project will provide Information Technology application design, deployment, monitoring, and maintenance experience. Prerequisite: MSIT 665 and (MSIT 662 or MSIT 664).

MSIT 691 Special Topics in Information Technology (3 credits)
This seminar focuses on the professor's current research interests. Requires consent of course professor and program director.

RESD 600 Introduction to Research Methods and Statistics (3 credits)
A basic, cross-disciplinary introduction to research planning and design, and decision making. Students will be guided from problem selection to completed research report with concrete examples and practical, how-to suggestions. Close attention is paid to quantitative research methods, qualitative research methods, and mixed-methods research. Students are prepared to conduct hypothesis testing using both parametric and nonparametric data analysis procedures. Students are also introduced to meta-analysis, and other strategies for interpreting research findings.

RESD 620 Organizational Assessment and Evaluation (3 credits)
This course focuses on the knowledge and skills needed to effectively assess organizational training, educational and developmental efforts. Topics include evaluation needs analysis, development of valid evaluation instrumentation, gathering information in a reliable and valid manner, data analysis and communicating assessment results.

RESD 630 Digital Research and Academic Writing (3 credits)
This service course will guide students through the components of writing a graduate-level paper. The initial steps include selection of resources, analysis of content, and preparation of annotations, the foundation sources needed for the content. Next, are the creation of a working outline and the synthesis of the annotations into meaningful sections. Last, is the discussion that makes the paper meaningful and adds something to current literature. A set of writing specifications for APA style, use of quotations, and writing and language issues will be distributed to be used as guidelines. Students will write within content areas that match their professional interests.

RESD 705 Quantitative Research Methods (4 credits)
This course presents an in-depth treatment of the research process from an experimental, developmental, and evaluative perspective. Techniques for planning and designing these types of research projects, as well as the methodologies for data collection, evaluation, and analysis are examined. Special emphasis is placed on the appropriate choice of methodologies for a variety of problem situations.

RESD 710 Qualitative Research Methods (4 credits)
This course provides a comprehensive introduction to the theory and use of qualitative methods in educational and professional settings. Emphasis on application level experiences such as identifying and developing research problems appropriate for qualitative investigation, study design, data collection, analysis, interpretation, and presentation of findings.

RESD 720 Multivariate Research Methodology (4 credits)
This data-driven doctoral seminar will provide the skills needed to perform advanced multivariate data analysis by incorporating current techniques. Topics covered will include assumptions and limitations, multivariate data collection, pre-analysis data screening, factorial and multivariate analysis of variance and covariance, linear and non-linear multiple regressions, path analysis, exploratory factor analysis, confirmatory factor analysis, and structural equation models (SEM). Students will be provided with datasets for data analyses of the multivariate methods discussed in the hands-on lab along with scholarly articles that make use of the multivariate methods discussed. Students will be introduced to the use of SPSS and other advanced multivariate tools. Prerequisite: RESD 705.

RESD 730 Mixed Methods Research (3 credits)
This course provides an overview of mixed methods research. Prior to registration, it is recommended that students have completed coursework in qualitative and quantitative research methods. Students are first introduced to the nature and foundations of mixed methods research and, from those theoretical and philosophical perspectives, various mixed methods designs are discussed with an emphasis placed on the reading and evaluation of prior studies. The course continues from an applied perspective with discussions and exercises focused on the identification of research problems or opportunities, the development of purpose and research questions, the statement of hypotheses and the choice, design and implementation of an appropriate methodological approach. The course concludes with consideration given to data analysis, reporting and presentation of conclusions.

Faculty and Staff of the College of Engineering and Computing

The Faculty

Gertrude W. Abramson, Ed.D., Columbia University. Professor. Online teaching and learning, distance learning programs and communications, assistive technologies, instructional systems design, development, delivery, and evaluation.

Charmaine Barreto, Ph.D., Syracuse University. Associate Professor. Human computer interaction, telecommunications and network management, web design, management information systems, systems analysis and design, project management, business statistics, survey design, research methods, library and information science, knowledge management.

James Cannady, Ph.D., Nova Southeastern University. Professor. Network intrusion prevention, detection, and response; complexity theory and complex adaptive systems; machine learning; information assurance.

Maxine S. Cohen, Ph.D., State University of New York at Binghamton. Professor. Human-computer interaction, interaction design, user experience, social media, and online learning.

Travis J.A. Craddock, Ph.D., University of Alberta. Assistant Professor. Molecular systems neuroscience, computational and theoretical studies of subatomic radioactive decay, subneural biomolecular information processing, nanoscale neuroscience descriptions of memory, consciousness and cognitive dysfunction.

Laurie P. Dringus, Ph.D., Nova Southeastern University. Professor. Human-computer interaction, information systems, computer-mediated communication, computer-supported collaborative work, interaction design, user experience and usability evaluation, and online learning.

Timothy J. Ellis, Ph.D., Nova Southeastern University. Professor. Multimedia design and application, application of database technology to education, online learning environments, adult education.

Vivian I. Haddad, M.S., Nova Southeastern University. Lecturer.

Paul E. Kenison, D.Sc., University of Massachusetts at Lowell. Associate Professor. Data structures and algorithms, programming languages and programming contest.

Michael J. Laszlo, Ph.D., Princeton University. Professor. Computer graphics, data structures and algorithms, software engineering, programming.

Yair Levy, Ph.D., Florida International University. Professor. Security and ethical issues with Web-based and e-learning systems, end-user computing, cyber-security skills and competencies, cyber-security awareness and cyber threat prevention, as well as experimental research design.

Wei Li, Ph.D., Mississippi State University. Associate Professor. Computer security, network security, software engineering, artificial intelligence, database systems.

Peixiang Liu, Ph.D., Imperial College London. Associate Professor. Computer networks, QoS routing, database systems, machine learning.

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Thomas MacFarland, Ed.D., Nova Southeastern University. Associate Professor. Institutional research, assessment of student learning outcomes, Federal data resources, K-12 computer science education.

Frank Mitropoulos, Ph.D., Nova Southeastern University. Professor. Programming languages, data structures, software engineering, object-oriented design, mobile application design and development.

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